The Journal of
SOCIAL ISSUES

1961 VOL. XVII No. 2

Social Psychological Implications of Man in Space

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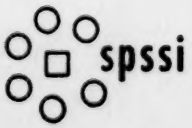

XVII 1961 No. 2

THE JOURNAL OF SOCIAL ISSUES

Published Quarterly by

The SOCIETY FOR THE PSYCHOLOGICAL STUDY OF SOCIAL ISSUES

A Division of
THE AMERICAN PSYCHOLOGICAL ASSOCIATION
Annual Subscription: $4.00 Single Copy $1.50
(For prices on back numbers see last page)

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The Journal typically publishes a whole number on a single topic. An occasional number will be devoted to contributed papers relevant to the purpose of the Journal. Proposals for new issues and individual papers should be sent to the General Editor.

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Back Numbers: Orders for one or more copies of a particular issue or supplement should be sent to Acme Printing and Reproductions, 611 South Maple Road, Ann Arbor, Michigan. (See inside back cover for a listing of recent Journal numbers.)

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Introduction

Herbert E. Krugman and Donald N. Michael

Heretofore the conquest of the elements has affected public imagination more in terms of adventure than in terms of science and planning. Thus the voyage of Columbus is still seen as a daring venture into the "unknown" despite ample documentation of the extent of knowledge available to him at the time, and of the meticulous planning in which he engaged. Similarly, Lindbergh's flight across the Atlantic brought fame and fortune while his two previous flights (California to St. Louis, St. Louis to New York) enroute to his Atlantic take-off point at Roosevelt Field, shattered the then distance records, demonstrated the capacity of both pilot and machine, and yet were almost ignored in the press of the day.

In these times, however, the sure knowledge that a variety of momentous space events are in the offing presents our social scientists with an unparalleled opportunity to *prepare in advance* the methods and research designs which can make use of those events, and their impacts, for the advancement of our understanding of social change. Already there are many signs that these events are going to be different from all their forerunners. This time questions of science, technology and planning, human intellect, even human nature, *are* in the public speculation. This time, moreover, is a time of more rapid change. Thus, if starting with the Wright brothers one plots year by year the maximum speed of aircraft one will discover a geometric rather than arithmetic progression. Similar progressions may be drawn for kilowatt hours of electricity produced, for gross national product, and very likely for information produced, i.e., products of our communication industries. In short, the past fifty years have seen a rapidly accelerating pace of technological change. What about the rate, or rates-to-be of social change? What can man in space teach us about the nature of such change, and what effect may it have on the rates involved?

With such questions in mind, SPSSI council in 1958 invited Herbert E. Krugman to organize a Work Group on the Social Psychological Implications of Man in Space. He then invited Donald M. Michael to co-chair the group. Joseph Fink at the Systems Development Corporation was, in turn, invited to form a West Coast sub-

group. Gardner Murphy was appointed somewhat later as council's advisor to the group and the group's representative in SPSSI council.

For the first year of its existence the group was very much involved with evaluating questionnaires and similar data on the initial impact of Sputnik and other early satellites on the American public. During the same period other organizations such as the Opinion Research Corporation at Princeton and the Survey Research Center at Ann Arbor began reporting in detail the impacts of Sputniks or lack of impact, on public attitudes towards science, education and cold war politics. As striking as some of the superficial impact thereby reported was the note of easy accommodation to the new events evidenced in the public mind. Thus, after the SPSSI work group reviewed such findings in an APA symposium (Cincinnati 1959) Gardner Murphy took the point of view that the typical social scientists' rush into data collection was not adequate to the challenge at hand, and that more daring speculative activities were urgently required. During 1960 therefore the work group evaluated a variety of perspectives, discussed the possibility of new methodologies, and generally tried to immerse itself in the diversity of the problems related to MIS.

From these efforts came an appreciation of the deep significance of the issues involved—and a desire to share this appreciation with others. This issue of the *Journal* is intended to serve this purpose.

On the one hand are issues involving the potency of science and the human intellect, and on the other are issues involving the subtle complexity of social change. The essence of social change derives from the ability of societies to assimilate selectively new and especially strange new ideas. But this ability has been cultivated to its highest order by precisely those scientists who are getting us out into space in the first place. Gardner Murphy put it very well in his 1944 APA presidential address on "The Freeing of Intelligence":

> "The physicists have discovered a superior way of handling unassimilable ideas, 'outrageous hypotheses.' They have learned since Faraday's time, as every year brings discoveries which just don't fit into classical physics, to invent mathematical descriptions which simply denote what the evidence reveals, treating events of the older physics as one special class of events comfortably housed within the mansions of the new. The local autisms of the physicist have in large measure been washed away by a stream of mathematical symbols. In fact, most physicists do not seem interested in defending any final world view. In the open spaces of mathematical invention there is no such constraint. And the odd thing is that this kind of free thinking pays the hugest dividends which any scientific effort has ever yielded."[1]

In a sense, the physicist has achieved a kind of culture free

[1] *Psychological Bulletin*, Vol. 42, No. 1, January 1945.

detachment permitting fluidity of ideas. Part of his freedom, however, is the certain knowledge that the unknown is greater than the known. Thus he can always feel that he and his science are at the beginning rather than at the end of a long journey. Can the non-scientific public feel this way about the knowledge of what is good in society, of what constitutes good government, good laws, the good life? Will man in space unfreeze established perceptions of the world and of the lot of mankind? And, closer to home, can social science take special advantage of MIS to permit a greater fluidity of ideas, to find a more stimulating and productive laboratory for the study of man?

The contents of this issue of the *Journal* are intended to portray the diversity of impacts of MIS and of the theoretical and research opportunities involved.

The articles begin with one by Gardner Murphy in which he explores the grandest of all possible MIS impacts—changing the nature of man himself over the long period of man's growth into space. Sells, in the second article, makes broad inventory of the diversity of impacts on contemporary institutions and activities and documents the impressive extent to which they have already become part of our way of life. Milburn discusses the space crew as a laboratory for group living, a laboratory which will pose questions for psychology with implications far beyond the confines of space capsules and ships. Fink takes a searching look at missile communities where thousands of families are already living in the midst of day-to-day rocket tests, space probes and "thunder in the hills." Metraux and Winick have examined special kinds of data, the one on children's drawings, the other on jokes and anecdotes, to tease out perceptual subtleties in reaction to MIS. We take the horizon for granted: Will our children experience it in the same way as we do? Why do space jokes rarely include references to women?

Bauer notes that the economics of the space effort should challenge the conventional wisdoms held by business, yet it easily overrides them. How much impact shall MIS have as a super make-work project? Egypt achieved its grandest role in the history of civilization while busy with the apparently useless task of pyramid building. Might not Arnold Toynbee see MIS in its own right as an adequate "challenge" to our society?

The diversity of MIS impacts also raises problems concerning the optimal *strategy* of social psychological research and these are discussed in the last article. In his inventory of the areas involved Wiebe suggests that some bureau or committee be established with the mission of identifying incipient social problems spawned by technological innovations and bringing their implications to the attention of appropriate groups. To the editors this suggestion seems worthy of specific recommendation to SPSSI Council, especially since the formulation of more revealing methods of identification, and more

exact criteria for selection would in itself represent a set of valuable tools with which SPSSI may more effectively channel the contributions of social psychology to the full panorama of social issues.

In all, the editors believe that these articles demonstrate that while Man in Space may not be *the* issue of the 1960's it does bid fair, along with War and Peace, to be the issue of the twentieth century. It merits, as such, the knowledgable awareness of all those interested in the role of the social sciences in understanding and meeting social issues.

Testing the Limits of Man

Gardner Murphy

So we are in space. Apparently we have been so for some time. The last thing, we are told, is that a fish would be aware of is water. As of 1960 we are growing aware that we really are in space, as the king depicted by Moliere realized that he had been talking prose all along. Only we are in space in a new way; not just that it's a big space for the astronomers have been telling us about light years for a long time, and we speak simply of "astronomical" figures to represent our littleness in relation to the vastness of space—no, the distinction goes deeper. It is that this vast space is in a sense ours as it never was before. In the various kinds of time machines represented by H. G. Wells and others, the scientific imagination has followed the religious imagination in telling us that we are in time; that eternity alone can get a temporal dimension for us. Today the astronauts are to be shot not just to the moon but to Mars and Venus, and the old arguments about the impossibility of this and that fade out into improbabilities and unlikelihoods of various sorts with reference to which the imagination totters and grows weak. It is bad enough to have space defined relatively, curving back upon itself. We cannot tell where our space stops; how far we, as humanity, may extend.

There is a vast literature already about man in *space*, but almost no literature about *man* in space; the psychological dimension of our readiness for space, our capacity to make space ours, has been strangely lacking. It will take more than rockets and launching pads to propel us into space. We are deeply stained in our whole tradition of earth living. We are earthbound. Whole series of volumes tell us about the physics and chemistry, yes the mathematics and even the philosophy of living in space, but they do not tell us how we experience space, how we feel space, how we make ready for new space, how each kind of space leads into another and that other into a third, just as each step in rocket propulsion leads to a new stage contained within the bosom of the first. We do not yet know how the psychology of everyday space as we experience it in our own bodies and our own surroundings is to yield to the space of tomorrow, with new definitions of stratospheres and ionospheres, and these into weightlessness, atmospherelessness, and the aching and throbbing emptiness of the

light minutes that take us to the planets, and the light years that take us to the stars.

The facts with which we begin are of the following sorts: Place a man in a small, dark chamber with no communication with his fellows and simply ask him to stay there. In some of these experiments no sound can reach him; in some there is restriction of movement of hands and feet; in some restriction of movement of the whole body except the musculature of the face; in some there are a few simple activities which he can carry out; indeed, in some he can raid the ice box for food; in others there is nothing to do except insofar as he may recollect the past, make up stories, or plan the future. The one thing common to all these experiments, however, is the loss of contact with the world, especially the social world. For a few hours all may go well. Difficulties tend to increase. Sometimes the "panic button" is pressed. Why so? There is no danger. Or is there really no danger? As we inspect the situation more closely we find that cutting off the external world removes the counter-poise which is ordinarily used against disturbing thoughts, memories, impulses. It is as if we stood continually in the middle of a see-saw where the weight is a bit uneven, and we must ourselves control how high up the threatened movement may occur. Many a subject tells us frankly that he became uncomfortable or panicky because of the removal of the vigorous external stimulation which ordinarily marks the course of our daily living. There is indeed normal casual phantasy, with or without symbolism; and there is of course plenty of time for both fitful and refreshing sleep. The fundamental problem, however, to which Rapaport draws our attention, is the problem of what happens when the massive internal forces in the whole history of the social control of our childhood impulses, the world of orderly and sound socio-cultural behavior, ordinarily maintaining its discipline and order through a meshing and coordination of inner and outer controls, is forced to do its work alone; of what happens when the space and time demands of the cultural environment are no longer there.

What happens is that the inner forces get out of control. Sometimes the hallucinations and delusions which appear seem rather fragmentary, or fluid, or meaningless, like peripheral materials cast loose from their moorings in a storm, tossed about until they settle at some point on a littered beach nearby. Sometimes they seem sinister and somber, meaningful and threatening, as if they were symbolic portrayals of the forces which threaten our integrity; instinctual forces perhaps, or forces representing a rich amalgam of primitive with more complex, impulsive patterns which we thought we had tucked away out of sight, swept under the carpet forever. Sometimes they are more transparently real in their implications. We see all these same things under conditions of delirium and overdoses of drugs, or indeed frequently in connection with the modern "psychotomimetic" drugs

like LSD. The more primitive chemical effects of the drug on the brain are not here primarily involved; the primary phenomenon is the effect of the drug in releasing primitive tendencies either through directly stimulating, or more often weakening the controls that hem them in, weakening or tearing loose the various safety valves which keep them down. Much of the language of these hallucinations and delusions is itself directly spacial. But our concern is not with this rather simple and primitive effect. Our concern is primarily with the posting of the sentry between inner and outer, and the loss of control which that sentry undergoes under special conditions of social isolation or biochemical impacts from drugs.

Of course the story of man's invention of skins and tanning processes as a device to keep him warm in the dead of a European or North Asian winter; the story of his learning to cope with his foods and drinks, which are certainly not a part of his natural habitat; his capacity to invent abstractions and forms of self-deception which can go so far beyond the animal level, must all be written down as parts of his creation of a new artificial environment. This story would itself take encyclopedias to spell out. Here we are concerned rather with the simple fact that man's special habitat has itself already developed a second order of reality for him. He must in a basic sense maintain all of the laws of the first Decalogue relating to the physical commerce with the special environment about him. But he must at the same time invent and maintain commerce with a socially contrived and invented environment, with its own subdivisions of space and its own demands no less imperious. The difference, however, between adaptation to the first and adaptation to the second environment is profound indeed. A deep-sea diver can "live" almost as well inside his diving suit several fathoms down as he can live lying lazily on the sands or grasses of a vacation spot. But the price of maintaining him alive and at work inside his suit is eternal vigilance, not only of himself but of those who supply the air and the instructions, the life line and the operating code which give meaning to this second-order kind of life. The problem of man in space is merely the climax of a series of problems which have arisen from man's inventing a series of new worlds to which to adapt. It becomes evident at a glance that the successful astronauts, those who plan their flights, those who guide them, those who interpret the meaning of the first flights and plan the next series of flights, are all governed by a more than terrestrial kind of logic, a more than earthbound law of principles of adaptation. The astronaut must be utterly equal to the physical demands. This goes without saying. He must, however, be one who can think in terms of weightlessness, near absolute zero of temperature, incredible monotony, the posting of the little guard that we mentioned which will take care of his own inner promptings when the firm structure of the familiar external world is gone. He must be

a man who in a sense imagines reality in terms of the coordinance of inter-planetary or inter-stellar spaces in which our own little earth is hardly a speck at the corner; and he must be capable of imagining a range of environments in terms of temperature, gravitational pulls, concentrations of masses of energy which have almost literally nothing whatever to do with all the assumptions of ordinary here-and-now physical existence. At the very time that his own little physical manhood in his little skin capsule and his little rocket space ship must be safely maintained and with a margin of safety, he must be functioning in terms of another kind of space—capable of imagining kinds of space; meanings of space, which are in a deep sense anti-biological, or even, if you like, anti-evolutionary, anti-here-and-now, philosophically contrived, mathematically conjured up modalities of spacial existence. This might seem to mean that he must become less of a man or no man at all. On the contrary, it is only by remaining fully man that he can become this special kind of a space man. All this is independent, of course, of the future evolution—biological or cultural—by which new kinds of men may be engendered, in the space in which Nietzsche's Zarathustra conceived a superman. That is only for a dim future to spell out. Almost here and now, that is, within the course of the next years or decades, the new kind of man with only the torch and searchlight of science, mathematics, and philosophy, must imagine himself into the new kind of spacial existence which is involved. It is only by very fully understanding his biological limitations, his nature as man, the nature of the space which he, as man, has divided and subdivided, the investments that he has made in space—personal, social, economic, political—only by recognizing the enormous debt which he bears to space in the course of his biological evolution, that he can ever hope to transcend this space in favor of a new kind of space. He can solve such problems sporadically or in a piecemeal fashion by the methods of engineering and biology already in use. He cannot, however, solve them in any deep sense, a sense launching him upon a true man in space era, unless he defines far more clearly and fully his relation to past, present, and future spacial existence.

All of these problems about the kinds of worlds in which man might be able to live lead ultimately into the problem of what man can tolerate. There is no doubt that he can make himself, as time goes on, more and more comfortable in a cold and airless world by means of artificial heat and artificial air circulation. But sooner or later he pushes into worlds which are less comfortable until he imagines that which is at the borderline of his tolerance. Man has always done this. When the Eskimo hunter goes out into the Arctic night, it is likely to mean that he will return with a seal or just won't return. Men under torture have often stood very much more than we can medically understand and indeed, have inflicted self-torture

upon themselves which is beyond any ordinary imagination. Under the pressure of military discipline men could go month after month into the inferno of the bombardment of Verdun in the first World War, or the Anzio Beach-head in World War II, or the brain-washing ordeals of the struggle in Korea; men and women have often maintained "unbearable" pain and stress until they have fainted or have passed into a state of shock. These are not just problems of tolerance in the physiological sense, either. It is true that one can to some degree predict which men will be able to "tolerate" various kinds of stress, but the factors of control are almost as mysterious to us today as they were in the days of Spartan—or Iroquois Indian —unflinching stolidity and silence under the most exquisitely conceived and ravishing tortures of their enemies. All of this is relevant as we ask about the extension of the boundary of the habitats in which man can live; they are all relevant to the question how fast and how well space is to be conquered. The problems are surely largely technical; but they are also to a very large degree questions of morale, individual and social. In World War II, a man who had been screened by H. A. Murray and his associates and considered fit for perilous and responsible work overseas, was captured by the Germans, subjected to one gruelling stress after another, but yielded no military information. The Germans then began knocking his teeth out, and went on with the examination. Still he gave no information. Later, after the ordeal was over, he went into a "fugue" state, that is, having lost awareness of his own identity and whereabouts. Did he have tolerance or not? Such metaphysicals as these, essentially unanswerable, are replaced by such questions as: What kinds of stress can he tolerate, under what kinds of conditions? He could bear much more than most of us can bear. Many an astronaut may succeed in bearing much more than most of us can bear, but not come back to narrate the tale in an intelligible form; or indeed he may far outdo what we think of as "human," and come back with a coherent report.

In short, we do not know very much, really, about the concept of tolerance from a psychological point of view. It is quite different from the physiological tolerance described in the paperbacks that tell us about space travel, old and new. Rather, such facts and speculations lead into a new vein of possible discovery which we should now like to exploit for a few moments.

The issue is actually: Where do the limits of human nature lie? What, after all, is within the human limits? Or, if you like, what is human nature? Over and over again through the history of war, punishment, disease, torture, and unbearable stress, we have learned more and more about what sort of thing man is. Indeed, just as many a man survives in a rather incredible sort of way the onslaught of disease, as many a hopeless tubercular case or case of malignancy has defied normal medical expectations, and as many "hopeless" de-

teriorating psychotics have come back to sound and effective social living, we have no yardstick to measure the human adaptation level. In fact we must press the point home and insist that tragically enough it is only by bearing more than they can bear that men find out who they are. Even at the simple level of living on sub-standard or famine diets, we learn something about how long men can keep going with scarcely any food. As we study the miners of the high Andes who work in the mines at 20,000 feet during the day and come down 3000 or 4000 feet in the evening to play soccer, we learn as we watch their way of life, the shape of their chests, the form of their respiration, the character of their red blood cell supply, a great deal about what is possible adaptation, even within the ordinary normal range of human adaptive possibilities. So every form of stress which pushes men beyond what they ordinarily can take teaches more about the latent potentials of mankind. In the intellectual, artistic, and creative fields generally, the same is regularly true. A good many of us are lazy a good part of the time. We do, however, catch on fire with love of tones, or colors, or numbers, or specific kinds of activities, and we drive ourselves joyfully on and on to greater and greater mastery. Almost everyone given the freedom to pursue his own intellectual and creative loves can far surpass himself. In the same way almost all who become interested in the new worlds to conquer that are opening up today beyond the atmosphere or under the sea are likely to find a break-through here and there into that which never was on sea or land. It is partly a matter of testing the limits, physiologically, testing the combined limits of all the various organs and systems of organs whose real maximal capacities are unknown. It is partly a question of pressing in the same way upon the nervous system to see what kinds of function it can still maintain under conditions which have never yet been created and applied, for the sake of the test. It is partly, however, a question of a vast array of unknown factors having to do with the will, or esprit de corps, or morale, or a creative potential, or a capacity for self-realization—these are essentially phrases the real meaning of which can only be discovered as their embodiments become clear in empirical work yet to be done—until the time comes when several men can do it, and it becomes the norm. Swimming the English Channel, running a mile in four minutes, climbing Mt. Everest—these are all examples of increasing virtuosity and technical skills in mastering a particular activity, but also steps towards focusing energies never previously focused. As we learn how the focusing is done, we learn not only skills, but areas of basic knowledge about what man can become. A man must do it, then men can do it, then it is common human.

It may well be remarked that most human beings are going to continue to live here on the flat face of terra firma; that they are going to go on breathing ordinary sea level air; eating ordinary animal

and vegetable foods, riding horses or tractors; pushing pens or sitting on river banks waiting for the fish to bite; that not more than one one-hundredth of one percent of men will be space explorers or the inventors of new ways of exploring space; that men will never get very far out into space because of fundamental physical and physiological limitations of the breed and of the physical means of which it can hope to control. Now let us suppose that all these sober and restraining thoughts are completely sound. They simply miss altogether the point which is here, trying to get itself conveyed. Throughout his history, man has tried the art of discovery on things around him and not very much on himself. Medicine has worked with the methods of authority rather than looking down microscopes or watching body fluids in test tubes to see what happens under special conditions of pressure, temperature, sunlight, and so on. The whole science of medicine has been created by looking at man and his works, his interactions with the world under certain special and limited conditions which are admittedly, in fact very gloriously, specific to certain creative laboratory settings. It is not what would ordinarily happen or indeed even what highly dramatic event may happen, that interests us here. We are concerned rather with the process of discovery. Discovering something about the evolutionary limitations of mankind and ways in which he can create a new environment may mean that he will fundamentally alter his relation to his environment, and may in the course of time see more clearly into his own structure and function. As Toynbee would say, the responses made by the combined threats and possibilities which all the new problems of gravity, radiation, oxygen deprivation, stimulus deprivation present, offer us a veritable hornet's nest of challenges that cannot be silenced. Nor is it enough to say that science would ordinarily have offered us such a challenge anyway. Science most of the time is concerned in a natural human setting, of pushing into the natural state of our human life and recording cases of unusual stress in terms compatible with ordinary humanistic consideration for individual life. Now we are rapidly getting ourselves into a new, and if you like a very awful dimension, perhaps more awful than other kinds of war hazards, even than those having to do with the most violent explosions and the use of liquid fire. For without undertaking to torture any man, we are solemnly undertaking, a step at a time, to find a whole array of limits to what man can bear, and therefore limits to what he can be. The whole spirit of the enterprise is different, from torture on the one hand and from the exigencies of war demands upon the recruit, on the other hand. We have to do with special volunteer populations who are willing to be pushed to their limits in a half-dozen different dimensions. This has its repercussions upon the men, their families, their communities, all who identify with them, and ultimately upon our conception of what man can

do to surpass man. This cannot be compared with what one learns from, say climbing Mt. Everest, however heroic this is, for this is an expensive, unnecessary, personal, and national form of competition in prestige and power, utterly different from the strenuousness of men undertaking a task of the direct military and political importance. Nor can this be compared in essence with the heroic volunteer activity of those who allowed themselves to be bitten by mosquitoes under conditions where death from yellow fever was a probable consequence. These heroic acts are all part of the vast forward platform which carries man to a new definition of manhood. We have here, however, with the impending travel of the astronauts, a systematic, scientifically planned, nationally fundamental and sacred endeavor, stretching out beyond all that man has ever known and been, entrusted to a few highly selected for the task, whose utmost in physique and in mind and heart will be demanded of them. It is likely that this attitude, brought to its intense form by competition with the Soviet Union, will become part of folklore very similar to the folklore which has gathered around other explorers who went into the unknown conditions of enormous hazard; but it will mean much more symbolically; and it will achieve much more by way of teaching what the physical and psychological resources of men under stress, men under maximal motivation, may become.

Man is in space to stay. He has been "in space" since the primal ooze; since his ancestors crawled from the sea, from the earth; since he swung in the branches; since he painted the walls of Spanish caves. But he is in an utterly new world of space today, and he has hardly felt the shock of transition. Tomorrow men will land on the moon. A few years later—it matters not whether it is five or ten or fifty—he will look back from Mars at the shining face of mother earth with moon around her. If successive wars do not utterly mow him down, he will begin to extend his colonies with little artificial space contrivances to make life somehow "like home", at least for brief periods. And what is probably more important than all this, he will take on a new viewpoint, will begin to come back and tell those at the fireside what the world looks like from these new perspectives. The sciences of astronomy and geophysics are only the beginning, too. Darwinism established a new perspective on the transmutation of species and the terrestrial origins of man. But even the century which has elapsed since the origin of species has only begun to write out the implications in terms of man's inner structure; his affinity to his humbler animal brethren, his place in cosmic structure and destiny; the relation of the stuff of which he is made to the stuff of which the cosmos is made. In the same way, the space which he now enters, whether he samples it in a frugal way or makes gargantuan feasts of it in the immediate years ahead, will begin to open his eyes to more and more implications as to what he is, who he is. As in the case of

countless voyages of discovery in the past, the solitary wanderer like Marco Polo may be disbelieved. But there will soon be cross-validation from men of different training and of different cultures.

Whether these men of different training and different cultures will begin their explorations of space in competition or in cooperation, in frightened and savage attempts to fend themselves against expected attack or in the furtive hope that something common-human may be achieved, whether the first steps are national or international in spirit and scope, we have seen enough in recent years to be morally certain that they cannot last long on a competitive nationalistic basis. Man is too basically man. The likelihood of destruction of one or both of the powers who first used the ultimate destructiveness of modern weapons will be followed inevitably by a period of relative uniformity and integration of human effort. Using space for a strategic and tactical assault could, for a few years, be maintained if the task is one of reconnaissance, of preparation, of threat and of counter-threat. The period for which we are writing here, however—not the period of the first brisk encounter with space but the period of its gradual penetration and control—will be a period in which the human family, under whatever political form may evolve, will extend its space explorations. We do not say conquest of space as man spoke of the conquest of Mt. Everest or the conquest of the polar regions. Men do not sit today on Mt. Everest, and those who sit on the South Pole are maintained at enormous personal cost and enormous national economic cost in an environment for which there are severe physiological limitations. These limitations are almost nothing compared with the heat and cold, the oxygen lack, the radiation hazards which, as far as the eye can penetrate the future, will make all but terrestrial worlds uninhabitable by man except on the basis of the enclosed capsule, the little space fortified against the great space which we just mentioned. It is not the supposed capacity of planets to care for an expanding human population that concerns us here; for even Mars, far the best of our prospects, would have to be remade for such purposes—but the new vantage points, the new perspectives, the new understanding of ourselves, which constitute the meaning of the new space age. By this new space age we mean the period belonging to the immediate "foreseeable future," a period of a few decades or centuries, prone though we may be to the visionary and the prophetic, knowing that we shall not be living long enough to be tormented by our wrong guesses. It is essentially the exploration of the little space near us, that space belonging to our solar system, that must mainly concern us here. Buck Rogers, H. G. Wells, Claf Stapledon, and the space mariners of science will soon be given an extended and an expanded life, as with our new equipment we reach Alpha Centauri only a little over four light years away. A man may still be young when he returns, and his beloved may wait for him almost as the

whalers' wives of Nantucket waited for their husbands, and indeed with far more frequent messages from the wanderer. This, however, we are persuaded, belongs to another chapter, another book to be written by our descendents who have survived the atomic hazards and the space hazards of today.

Tentatively, we think today of a few men who will be lost on the early astronautical flights—heroes like those who died in flying the Atlantic, or in climbing Everest, or in approaching the South Pole, or in a sense like the heroes who allowed themselves to die of yellow fever in efforts to control humanity's lot. It is not, however, a few such men alone who will be lost. Ordinary civilian aviation, not even to speak of military aviation, takes its thousands annually, and we go right on. Indeed, high speed motor cars do the same, and we go right on. We shall launch more and more objects, then more and more men into space. Many will not return but we shall go right on, partly from scientific curiosity, partly from military urgency, partly because when invention has made a breakthrough there is no cultural force which can stop the forward thrust. There is not one motive ready to push ahead through the breakthrough which has been created. Other motives will take care of the matter. Man is about to go into the great spaces. Some will go eagerly; some reluctantly; some will be pushed along by forces which they, themselves, may not understand, forces inside themselves or among their fellows. We may be perfectly sure that the trickle of tomorrow will be the stream of next day. We shall make a deep personal investment, an investment of all mankind, in the increasing success of this new kind of exploration. Having challenged nature, we shall not let her close the door.

Some Implications of Astronautical Research for Human Affairs

Saul B. Sells

The space age no longer approaches. It is here. Within only the last 3 to 4 years the technology of powered flight has taken the big step from jet to rocket power and we are suddenly in the space age. Most of the scientific specialties and industries which were long identified by the once glamorous adjective, "aviation," have now adopted the more distinctive designation "aerospace," and "aeronautics" has been replaced by "astronautics." The public has been kept surprisingly well informed of the successes and failures in missile shots as well as of a wide range scientific and engineering developments in exploration of the space environment, development of missiles, power plants, capsules and life support systems. Indeed, there is even a report of the House of Representatives Select Committee on Astronautics and Space Exploration describing further progress some experts expect in the next 10 years.

Space Forecast

In many cases the distinction between fantasy and reality in the prognostications, presented by this Committee and its scientific advisers, is acknowledged to be related to the timetable for various accomplishments and the priority and financial support allocated to them, rather than to their feasibility. A "conservative" estimate, by Capt. C. R. Truax of the Advanced Research Projects Agency,[1] forecasts the following for the period 1959-69, at a cost of $20 billion: "*numerous unmanned single-purpose satellites, one large manned multipurpose space station, circumlunar instrumented flights, a soft-landing lunar craft instrumented to make numerous surface measurements critical to a later manned landing, and a manned circumlunar flight.*" These are regarded by many experts as "real and solid," but considerably below what others regard as probable accomplishments.

[1] Robert C. Truax, Statement to House Select Committee on Astronautics and Space Exploration. House Document No. 115, "The Next Ten Years In Space," Washington, D.C., U.S. Government Printing Office, 1959. Pp. 204-211.

If the record of accomplishment to this date is a sample of what appears to be in prospect, the informed layman can have little reason to question this forecast. Since the Russian Sputnik, the United State has successfully launched meteorological and communications satellite prototypes in orbit, an X-15 manned rocket-craft flight into near-space and important experimental ballistic flights and recoveries of missiles carrying capsules containing animals and scientific instruments. Announcement is expected daily of even more important new developments, including at any moment, a man in orbit. As for the cost, few observers believe either the United States government or the Soviet Union are likely to drop out of the race for this reason, even though the expenditures required appear staggering.

Human Impact Problems

Although most of the exciting new developments of space are just now in the process of becoming, they have already had a spectacular social impact, in many ways other than the tax burden, and the indications are that their effects will become increasingly pervasive and profound. It is the purpose of this paper to point out some of the main areas in which this may occur and to discuss the types of influence that may be expected. If the impression is created of a rapidly changing world, and perhaps even the possibility of new worlds for man, beyond the earth, this is intended. There is every reason to believe that with the conquest of space man may be on the verge of a major discontinuity, a sudden leap ahead, in his struggle to master the Universe, which may truly be the beginning of a new phase, not a culmination.

The total space program represents a convergence of several lines of development, chiefly the advancement of military weapons in the form of long range, rocket-powered ballistic missiles, and the advancement of powered flight toward ever higher altitudes and greater speeds, requiring the transition from jet to rocket-powered engines. (The peculiar fitness of the rocket for extra-atmospheric propulsion over the air-breathing jet engine is that it carries its own oxygen supply for fuel combustion.)

Many earth-based technologies have been exploited in developing the sciences of space: e.g., propulsion systems with sufficient thrust to boost payloads into space, guidance and communications techniques, telemetry, data collection and processing, cryogenics and electronics developments including miniaturization and microminiaturization of instruments, radio tracking techniques. Also a variety of scientific studies have been undertaken to increase knowledge of the environment and thereby provide the basis for the environmental protection of man in a space capsule, and the maintenance of human performance under conditions of prolonged isolation while enduring various

stresses, such as the weightless state. These and other fields have expanded with the space program, with many results of direct, earthbound significance over and above their contributions to space technology.

International Political and Legal Problems

The dual aspect of space activities, both military and non-military, is an important factor in the study of social impact. In effect, the developing space technology has become an integral part of the cold war inasmuch as the propulsion demonstrated in the launching of scientific satellites can also be used for missiles carrying nuclear warheads. Space has therefore become a new frontier in law and politics. As early as 1951 the International Astronautical Federation made an initial formal effort to promote international cooperation in this field. More recently the General Assembly of the United Nations appointed an Ad Hoc Committee on the Peaceful Uses of Outer Space, with the task of examining the legal problems which may arise out of programs of space exploration. Among the critical international problems that may require codes of space law will be questions of how "high" above its boundaries national sovereignty extends; indemnity problems regarding damage from falling space vehicles; allocation of radio channels over the full range of frequencies; photography of the earth from satellites for weather and other (including military) purposes; navigational and communications controls using satellites; salvage controls over the recovery in space of useless vehicles, registration of space vehicles; and the like. Although of less immediate concern, attention has already been directed to international issues relating to passenger and cargo transportation in space, colonization of the moon and possibly planets, military operations in space, and even problems of sanitation interplanetary biological contamination and preventive medicine. Space crime and space property rights are believed to be problems for the longer range.

The recent international IGY treaty which bars the Antarctic to military operations is regarded by some as a model program for the cooperative and peaceful exploration and exploitation of space for all mankind. However, the confusion between military and non-military scientific goals will not be easily resolved because of their overlapping nature. Those who have studied these problems are in general agreement that the need for international regulation is increasing. Actions such as those taken by the United Nations committee which proposed international responsibility for controls are regarded by many as necessary to ease the developing tensions over the confused military and non-military aspects of space exploration. The development of international control and administration of space traffic would not only be a means of resolving the heated conflicts of

the early stages of space exploration, but may provide the seeds out of which new supergovernments will eventually emerge. Eventually the "galactic councils" of Buck Rogers may prove to have been visionary rather than fantastic. However, the reality of international machinery and cooperation in space controls appears destined for early fulfillment.

Economic Impact

According to Andrew G. Haley, president of the International Astronautical Federation, "The combined number of production workers in the automotive field in the entire world and the dollars spent on the automotive industry will soon, in each case, be equal to only a fraction of the astronautics industry."[2] The United States budget for space programs was over a billion dollars in 1960 and may reach 1.5 to 2 billion in 1961. This, of course, has had a direct impact on industry, with far-reaching results, illustrated briefly from information compiled by Nadel, as follows:

> Private companies are studying the commercial aspects of communication satellites, television repeaters, radio-telephone communications, intercontinental passenger and cargo transport, and even lunar and planetary travel.
>
> The electronics industry is undergoing a major transformation and expansion, stemming from developments in miniaturization and micro-miniaturization.
>
> Liquid and solid fuel rocket propellants have created a major new industry, which, together with that of rocket engine manufacturing, expects great expansion.
>
> Computers and data processing systems, with accessory telemetry and other implementing communications equipment have burgeoned with vast and constantly expanding military and non-military applications daily being developed. Many new firms have been organized, specializing in specific equipments for space systems and civilian by-products.
>
> The aircraft industry in particular and many established industries have shifted major resources into space lines. The chemical and metallurgical industries have developed new products to meet stress, weight and other special demands of space vehicles.
>
> Space-related employment is already massive, e.g. 16,000 employees, mostly on space activities in NASA alone. Many new occupational specialties are emerging, with special scientific training requirements, not only directly connected with missile manufacture, launch, tracking and recovery, but in support fields, such as structural analysts for space vehicles, space biologists and nutritionists, astrophysicists, agratomicists, and more to come.[3]

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[2] Andrew G. Haley, Statement to House Select Committee on Astronautics and Space Exploration. House Document No. 115, "The Next Ten Years In Space," Washington, D.C., U.S. Government Printing Office. 1959. Pp. 65-68.

[3] Aaron B. Nadel, "The Social Impact of Space." Research Memorandum. RM 60 TMP-63, Santa Barbara, Calif., General Electric Co., 15 September, 1960.

Educational Impact

The pressure on the educational system of the United States to produce scientists and technologists in support of the space race was felt "overnight" after the dramatic appearance of the Russian Sputnik. However, at times, the frantic drive to expand technical training narrowly in certain areas of science and mathematics also produced a staunch defense of broad liberal education and high academic standards.

The National Defense Education Act of 1958 is a consequence of the post-Sputnik pressures and scholarships have also been provided by the National Science Foundation, NASA, and individual institutions and companies. As the technical requirements of space industries and astronautical operations become felt these will be reflected back to the educational system. However, the most important impacts on education will derive from the expected changes in modes of living, travel, communication, and in the very fabric of the social system which seems reasonable to expect.

Cultural Impact

Any effort to assess the changes in material and non-material culture brought about by the space age must be a major undertaking. Examples presented here supplement the brief comments above on the economic and educational effects. These are selected to provide a wide range of illustrations of the impact of space.

Applications of technological developments in the missile industry are frequently used for their possible primary and secondary impacts on society. Examples include the development of new thermal industrial processes based on advances in plasma technology; development of marine devices for measuring distance and velocity based on a flow meter originally designed for measuring liquefied gases; a family of new plastic materials with a variety of industrial uses not presently fully appreciated; new ribbon coils, of very low cost, for automobiles, designed originally for missiles; a complete revolution in ground surveying methods, using electronic beams designed for ground-to-air missiles; jet drilling devices capable of cracking and crumbling stone layers by thermally induced expansion between 3 to 5 times as fast as rotary drill; jet piercing can go far deeper into the earth to new sources of ores and hydrocarbons than conventional methods; adaptation of infra-red processes in missile electronics, which cannot be jammed, to uses challenging radar for guidance, tracking and reconnaissance purposes, but also to new industrial uses in petroleum refining, metallurgical processing, photography and quality control. From such developments, the emergence of new products and processes that may be expected materially to alter present modes and standards of living.

The occurrence of new concepts and expressions related to them has already been extensive. Symbols of the space age that are already commonplace include sputnik, satellite, launching pad, and astronaut. Numerous other new concepts relate to sealed cabins, life support systems, trajectories and orbits. Attention has been directed to planets and galaxies, and scientific terminologies are being augmented and adjusted to the frame of reference of the expanding universe. Not only has "aviation" become "aerospace" and "aviation medicine," "bioastronautics," but "geophysics" will require a new term to embrace "selenophysics" (of the moon) and "uranophysics" (of celestial bodies), "chromaticity" will include new connotations relating to "color" in the light range of spectral radiation in space, and so forth.

Concepts of time and distance have already been affected by aviation progress and may shortly undergo a major change as the speed of human and freight travel jumps from about 2,000 mph (of the fastest military jets) to 18,000 mph (average speed of satellites) and eventually higher. The implications of the broad application of such developments challenge our imagination, particularly when considered in relation to the international political structures that are foreshadowed by the implementation of the space programs. There will probably be very little resemblance between the social, technological and political environment of the next generation of man and that of his grandparents.

Scientific Research Development in the Biosciences

Biological and psychological research on a wide range of problems of environmental protection, preventive medicine, and maintenance of health and proficiency have provided solutions to design problems which have made possible the significant accomplishments in high altitude, high speed jet and rocket flight to date. Men have stayed above 100,000 feet over 24 hours in balloons and animals have survived ballistic space flights in environmentally conditioned sealed cabins. A pilot has flown the X-15 into near space and landed it successfully.

Most of the scientific investigations associated with these accomplishments were carried out in relation to piston and jet aviation, but they are also applicable to rocket aerospace. The transition has involved a continuity in the development of powered flight at the point where diminished oxygen partial pressure in the ambient air made compressors and air breathing engines inefficient and pressurized cabins had to be replaced by sealed cabins and jets by rockets. Since at least 1957 it has been generally agreed that the reliability of the vehicle and problems involved in reentry of the atmosphere rather

than human protection were limiting factors to at least a brief orbital manned flight.

Before such flights, of at most a few hours duration, can be extended, however, a number of other human problems must be explored and, if serious, solved. Very active programs of research and development are in progress. What follows is a brief account of a few areas of research which may have important implications for life on earth too.

Radiation

At present the possibility of shielding the space-man from ionizing radiation is unsolved and strategic planning of trajectories to avoid areas of high intensity offers the only means of avoiding hazardous exposure. Meanwhile research continues to determine the type, energy and direction of radiations in space. Dr. Lloyd V. Berkner, President of Associated Universities, Inc., recently remarked that, "Space-motivated research to protect man against radiation is contributing to man's knowledge of the physics of the sun and of the cosmos."[4]

Weightlessness

Zero gravity has as yet been experienced by man for less than one minute of continuous exposure. From this experience the necessity of squeeze-bottles for drinking and other techniques of performing sensori-motor tasks have been appreciated but pilots have generally been unimpressed with weightlessness as a potential stress.

On the other hand, scientists are deeply concerned about effects of long-duration exposure, which cannot be predicted prior to experience. Webb has speculated that:

> "if a developing human being is not subjected to the stresses of gravity, his bones will not form in the way characteristic of an adult . . . (for example). If a femur were never the weight-bearing axis of the body, then that peculiarly Gothic type of lamellar architecture in the neck and trochanter would not develop. It will develop, however, after the individual begins to put stress, that is, begins to bear weight, on that bone.
>
> From this observation the awesome hypothesis is suggested that if man should multiply in space, as will happen in the foreseeable future, he will not, in the absence of gravity, develop the anthropological characteristics that are familiar on earth. His bones and muscles will grow a little bit differently, deprived of the formative stresses that weight provides. Observation of creatures on earth which live in neutralized gravity make it possible to speculate on what will happen to man, by analogy. The whale, for ex-

[4] Lloyd V. Berkner, Address to American Geographical Society, New York, Jan. 20, 1959. Reprinted in House Document No. 115, Washington, D.C., U.S. Government Printing Office, 1959. Pp. 21-28.

ample, was a primordial pig. He grew to an indefinite age and an enormous size. Fish, in whose lives gravity is neutralized by buoyancy, grow through indefinitely long lives to relatively enormous sizes."[5]

It may be that men born and raised in space may have a similar fate. The beached whale dies of suffocation because his muscles are inadequate to breath when his enormous weight is imprisoned by gravity. Perhaps this may be man's fate as well: if he adapts to the weightless environment of space colonies, he may be unable to return to earth. On the other hand, he will be freed of the yoke of gravity, which influences not only his growth, but also his energy expenditure. Man in space, without the daily penalty of one-third of his total energy spent on overcoming gravity, may find new sources of effort, have less need for sleep, and attain new heights presently undreamed of.

Isolation

At least three aspects of isolation may be of great significance for astronauts or their earth-bound observers: (a) confinement, i.e., restriction of movement, (b) sensory deprivation, i.e., reduction of sensory input from external sources, and (c) social isolation. For experienced jet pilots the early space cabin capsule may not be materially different on short flights from the familiar aircraft cockpit. However, *confinement* is expected to become primarily a habitability problem, related to comfort, recreational and work efficiency needs, as length of flight is substantially extended, from the order of hours and days to perhaps months and years. When serious research begins in this area, the experience of the submarine service and of a number of investigators who have studied shelter habitability problems and prison confinement problems will be of great value.

The *sensory deprivation* aspect of isolation has received considerable attention beginning with the work of Hebb. Apart from recognition of the dangers of monotony on very long flights, which requires attention to recreation, varied work patterns and habitability of the space vehicle, sensory deprivation per se does not appear to be a potentially critical problem to the space crewman. On the other hand, the results of research in this area, recently summarized ably by Cameron, have contributed much to the general principles of behavior.

The critical problem of isolation for the space traveller is the utter separation from all social support when he becomes physically committed to the mission. High altitude jet flyers have described the "break off" reaction, which is awesome even under conditions which

[5] Hamilton B. Webb, "Speculations on Space and Human Destiny." Chapter 14 in Sells, S.B. and Berry, C.A., eds., *Human Factors in Jet and Space Travel.* New York, The Ronald Press Company.

do not involve "commitment" in the sense experienced when one leaves the atmosphere and enters the hazardous expanse of the unknown in limitless space. The stress of this type of isolation has been studied in the reports of shipwrecks and in the experiences of Polar wintering-over personnel, each complicated by different patterns of threatening circumstances. Although many have failed, the records show that some men have coped with these problems successfully. To some extent the magnitude of this threat is offset by the motivation and superior competency of the space pioneers. Their experience will be watched with great interest.

Summary

This brief survey has commented on a number of aspects and by-products of the rapidly developing space sciences and technologies with particular reference to their impacts on society and human affairs. The research and development that has enabled the accomplishments in space thus far have for the most part been earth bound in support of aviation and military missile advancement. But even at this early stage the effects on earth bound society of the space activities is tremendous. When the principal outstanding technical obstacles to extended space operations are solved, man may establish space stations and embark on flights of long duration to the moon, other planets and perhaps beyond. Strange and awesome changes in the form and functioning of the human organism may occur when men are born and raised in the weightless environment of space. Perhaps they may be unable to return to earth. On the other hand, freedom from gravity may release capacities not previously conceived.

Space Crews, Psychology, and American Society

Thomas W. Milburn

It seems highly likely that within a year of the time that this speculative essay appears in print at least one man will have emerged into space beyond the mantle of air that encompasses our planet. Within a decade a small host of men and women will be experienced or incipient travelers in space as if to justify the occasionally heard assertion that space ("emptiness") should be re-termed the plenum ("fulness"). The spread of mankind through the solar system in the seventies and eighties of this century may affect conditions at home just as the movement of bees into a meadow affects the hive, changing the orientation and level of activity of the latter, though for somewhat different reasons. Millions on earth will see the exploration of the moon and perhaps of Mars through world wide television. Space technology and so space exploration promises, unless technical difficulties proliferate, to continue to be symbolic of scientific, industrial, and even political success to the many Russians, Chinese, Europeans, and Americans who must support such ventures. The conquest of space could represent both a signal achievement and freedom from the confines of one planet. It could also provide a fascinating new adventure for those men who, directly or vicariously, must achieve ever more and those men who enjoy escape from the mundane and seek the challenge that demands an aggressive spirit. But, without doubt, man's commitment to and involvement in the investigation of space begun for whatever reasons will catch him up and change him and his goals irreversibly.

The space ship will be a built-in laboratory for studying interpersonal conflict. The pressures encouraging destructiveness among humans will be unusually severe there. Solving them will be imperative for true effectiveness. Moreover, they are strikingly psychological problems.

The Need for Multimanned Space Crews

It seems likely that after the first short trials space ships will rarely be manned by one person. Sensory deprivation, monotony, and

the dangers to be encountered will require that two or more persons be included per manned vehicle. Also multimanned crews can increase the system reliability, i.e., increase the likelihood that man-dependent functions will be performed. Two or more persons can judge complex stimuli independently and compare their perceptions in such a way as to obtain both more accuracy and increased richness of perception. More important, a group of as small as two individuals can withstand several times the level of stress that one alone can take without malfunctioning. During World War II the Germans found a one man submarine a failure: one man could operate it effectively for no more than five or six hours; whereas two men could function well together for over a week. Persons with companions can tolerate more electric shock than one alone and even show an increased level of resistance to disease.[1] One cannot so properly speak of an environment as sensorily isolated when there is another person present. Friends and friendly companions, moreover, increase tolerance even to neutral stress compared to what strangers can achieve.

Two or more persons together can, by their very presences, serve to reassure one another and contribute to a more interesting environment. One man submarine crews failed because the stress of sensory deprivation and monotony while coping with a difficult environment —a lonely one where one's sense of helplessness in dealing with a powerful environment was severely heightened—was more than one alone could long endure. Certainly a single astronaut would not experience a lesser range of sensory deprivation, monotony, and aloneness, all extended over time, though the very first trips to the moon may have a quality of glamour and an extra sense of imminent danger that together can serve in part to counterbalance the effects of silence and weightlessness and a low level of perceptual change. (But on later, longer trips, the glamour will fade; and then men may habituate to danger and fail to respond to it as an alerting stimulus: danger may "adapt" out of awareness).

Interpersonal Psychological Stresses in Space

While companionship can reduce the effects of physical and psychological stress and makes these more endurable, crew members will be the chief source of stimuli for one another. They will be virtually the only objects in motion. Nearly everything else will be silent. Under those circumstances, one's companions can also become a major source of stress. Put differently, the necessary dependence of members of a crew upon one another to oppose the lonesomeness, the boredom, and the peril of space will provide another source of stress which could itself be deadly. Namely, hostile associates with

[1] E. W. Bovard, The effects of social stimuli on the response to stress. *Psychological Review*, 1959, **66**, 267-277.

whom one has an interdependent relationship. If the only objects of interest around are one's companions, then he finds it difficult to divert and disperse his cathexes. He directs these toward these complex stimuli. Under such circumstances one tends naturally enough to invest profound interest and feeling in fellow crew members. One will tend to love and hate them.

In American society, both love and hate can produce problems. One is much restricted in choosing whom he can like much and whom he is supposed to hate. Even when it is permitted to love another the perception of that feeling can produce strong anxiety, can be very threatening. Sometimes one can love another and yet be most uncomfortable about being loved. In *A Writer's Notebook,* Somerset Maugham writes of having enjoyed being in love on various occasions, but of having found being loved a discomforting experience. It is possible that the closeness or intimacy connoted by love can be more disturbing to most Americans than hating or being hated, both of which are rather uncomfortable feelings for most of us. In group therapy it is interesting to observe how frequently expressions of affection or affection-related anxiety can be dealt with only after the "safer" ones concerning hostility have been handled. Concerns with homosexuality (a forbidden mixture of two feelings, sex and affection) may take a very long period to emerge. For most Americans strong feelings are threatening, closeness to others can be threatening, even to the point of producing fear or loss of identity through some kind of fusion. On earth we can ordinarily get away from close relations with people. In space craft there is no such solution.

Ordinarily one handles threat most effectively by removing its source through being actively and destructively aggressive toward the danger. The substitute of repressing one's feelings, the psychologically poor man's mode of destruction, scarcely eliminates them. The hostility still dwelling may emerge more subtly toward others or may be directed toward one's self and appear as depression, apathy, and strong inhibition. Hostility directed toward others is likely to be perceived by other crew members as dangerous, calling for more suppression. In such an atmosphere, tension could grow very strong. The nearest analogue of which I am aware has been the situation where men in small groups have spent the winter in the Antarctic. There has been a tendency observed for some men in the Antarctic to be anxious, apathetic, and inhibited not only in action, but even in fantasies and feelings.[2] Also there was "scapegoating." These effects were least marked among persons with strong senses of personal identity who also possessed some capacity for laughing at themselves. Many of the others found the continued experience extremely difficult to bear.

[2] John H. Rohrer, "Human adjustment to Antarctic isolation." Department of Psychiatry, Georgetown University Medical School, Washington 7, D. C.

A Laboratory for Group Living

Psychologists should be able to contribute to the improvement of the social environments that space crews will encounter. A group psychotherapist named George Bach has developed the notion that for optimally creative development each of us needs to know people and relate with people in several different roles.[3] Depending upon how these roles are conceptualized, he would place the number at fifteen to twenty. Perhaps persons on small space ships or in otherwise restricted environments might suffer role-relation deprivation! It is certainly true that at present most persons do not change their roles so as to handle their own and their friends' emotional needs as Bach feels they ought. Most of us do not have nearly as adequate ways as we might (or as we would like!) for handling strong feelings. It is plausible that tranquilizers would be used to dampen the reactivity of the sympathetic nervous system but only if such would not reduce the capacity of the crew for dealing with emergencies or precision tasks. But the psychological approach to these problems would seem to offer more flexibility. Studies on the complementary needs of marital partners, could be relevant although I suspect that it is likely to prove most important to maximize group heterogeneity and tolerance of differences and of the idiosyncrasies of others.

Psychology Up There and Psychology Down Here

One might wonder whether it matters for society at large whether psychologists and their brethren in related disciplines solve the problem of the social psychological viability of space crews. Perhaps humanity on earth will ignore the model. It should be remembered, however, that a high status model, one with glamour, induces conformity. Mass communications can make the space crew model of group behavior very vivid indeed. Besides, assuming that psychologists contribute meaningfully to the problems of how to develop and maintain sustained group cohesiveness and effective social psychological performance; the stature and prestige of the discipline will climb, thus attracting able people (and even funds), and providing inspiration for tackling other difficult applied problems.

The phenomenon of group living in space, attacked perhaps more vigorously and directly because it is remote, removed from day-to-day problems, has much relevance for a large class of social relationships involving either affect or conflict or both. I have already implied that the crews will have something in common with groups working in psychotherapeutic frameworks. They might also turn out to be similar in structure and function to leadership oriented sensitivity training groups (as set up after the model of the Western Training Laboratory

[3] G. R. Bach, Unpublished paper read at APA, September, 1955.

for Group Development and similar West Coast management development enterprises). Such groups are designed to increase affective self-awareness, empathy toward others, and social skill based on understanding both of others and of group processes. Neither families nor small conferences (even international ones!) appear totally dissimilar to groups-in-space, who must develop mechanisms and techniques for handling creatively not only conflicts but all sorts of expressions of strong feelings.

It seems clear that a successful attack upon social space problems will likely add to the glamour of space travel and to the stature both of space crews and clinical-social psychologists who can suggest how to apply and to extend new understandings. Some of the same mechanisms that can protect the psychological integrity of space crews conceivably could help fill extensive psychological lacunae here on earth. Interpersonal conflict whether in the family, between supervisors and employees, or in the arena of international affairs, is the most dangerous single problem mankind faces in this century. If we can solve these problems in space, perhaps we can transfer the solution closer to home. What is more, I optimistically suspect that we can.

Life in a Missile Community

Joseph Fink

The intent of this article is to look at some implications of the missile and space age for life in the American community. We have raised questions about the impact of these technical advances upon our social, economic, and educational institutions. We have also tried to be sensitive to the perceptions of the community in regard to such changes.

Awareness of Space

In the foothills of the Santa Susanna Mountains, thirty minutes drive from downtown Los Angeles, and on the edge of the San Fernando Valley, huge rocket engines are undergoing static firing thrust tests. At night the sky is lit with a fiery glow that diffuses throughout the lower atmosphere; ground-shaking rumbles rise to a crescendo and then slowly recede. Newcomers to the valley interrupt their activities for a few moments. Oldtimers ignore the sounds. The children particularly have completely absorbed these events into their daily lives. Social scientists are often quoted as saying that a by-product of technological advance is the increase of fear and anxiety, but one does not seem to find the Atom Bomb in the back of the minds of the people in this valley.

The role of being sensitive to the approach of the space age has been relegated to science fiction by many and a chance remark to this effect (made at an APA symposium on "Man In Space") gave rise to this article. It seemed to this author then, and more so now, that there were a number of localities in the United States where the population lived several steps closer to the space age than we suspected. Some attempt will be made here to look at some of these populations.

Sources of Information

Consideration of how we change in the face of space and missile age advances could be done on a purely academic plane. However, we felt there were experiences in the lives of some of our communities which could provide a basis for extrapolating a trend.

There were four sources for information used here: (1) factual magazine and newspaper articles; (2) letters requesting information which were sent to Information Officers at existing and planned Intercontinental Ballistic Missile Bases in the United States; (3) letters for information sent to Chambers of Commerce in the communities located adjacent to anti-aircraft missile bases; and (4) personal interviews.

Interviews were obtained from military officers at various levels, Chambers of Commerce officials, newspaper editors and reporters, and other public officials. In general, the inquiry asked such questions as: What kinds of community reactions occurred when it was known that a base would be established nearby? If there were negative reactions, what happened? Were there social, political, economical, etc., impacts on the community? What evidences are there? Are these changing over time? What did responsible officers or military do in regard to influencing public opinion?

Most public officials and some military readily offered opinions, documentation, newspaper clippings, and so forth. Most of the Information Officers required greater authentication of the request and exhibited much more sensitivity to the question of the public's attitudes and past reactions (this did not appear to be a matter of bias by individual officers, but is more typical of the military structure within which information of any kind is less subject to release without the approval of higher authority).

Economic Impacts

Only a few isolated cases are needed to substantiate the tremendous economic impact upon most areas where missile bases are established. Since the locations of these bases are away from large centers of population, they frequently mean the doubling of amounts of monies spent locally. Intensive lobbying programs are undertaken by business officials and politicians who vie with each other in influencing the Department of Defense to place such installations in favorable areas. Sums of money are raised by local Chambers of Commerce, unions and public agencies to buy land for donation to the government as an inducement. Each Titan Base costs around $42,000,000 for construction and facilities alone, with instrumentation being another $40,000,000. Construction takes about two years from its start on such a base. (A typical reaction is the announcement in the *Rapid City Daily Journal*, Rapid City, South Dakota, February 1, 1960, that "Local 326 of the Operating Engineers has signed a two-year contract for construction work on three missile sites near Rapid City. Work will begin on a six-day schedule with three eight-hour shifts per day.")

Missile projects are "big business" and most citizens appreciate

this fact. The dispersal aspect of the missile program has spread the effect upon the American community to a much greater extent than, for example, the effect of the UN activities with their concentration in New York City. An interesting comment came from Grand Forks, North Dakota, where a psychologist collected some information. His comment was, "It might be worth noting that the air base coming to Grand Forks actually provided a stop-gap for the economy here rather than developing a boom. For example, the Armour Company and the District Office for International Harvester left town just prior to the air base coming in. At the same time, many of the farmers in the local area put their local farms into soil bank and departed for warmer regions in the south. These factors began to have a crippling effect on the community here. The coming of the air base has stemmed this tide."

The implications in such remarks are obvious and far beyond this paper. A well-planned use of the monies alone, which are involved in the billions of dollars of contracts let, can have an invigorating influence on the United States community.

Sensitivity to Becoming a War Target

The military agencies involved in the new order of missile men have been constantly aware of possible local public reactions toward a community becoming a target area. These kinds of reactions crop up on various levels with small but vocal minorities—insignificant in terms of numbers—voicing protests against the establishment of military bases. There are several incidents recorded—such as that of the McDonald Committee in Tucson. Here, the location of the hardened (underground) sites was questioned because of fall-out possibilities (in this case it was not the Tucson location that was in question, but the prevailing wind pattern and where fallout might occur in case of an attack). Other incidents have been "Citizens Committee for Peace" meetings and some "Acts for Peace" demonstrations. The letters to the editor and the public forums (both of which have been scanty) are slanted toward pacifist policies, arms control, and the dangers of world wide nuclear war. One finds little sensitivity to target risk on the part of communities and individuals, with practically no response to war danger in most areas. The editor of one newspaper in a fairly heavily populated area thought that, "either the people were not aware of being near an ICBM Base, or they were aware and didn't realize its significance, or else they just didn't give a damn." The inference that can be made here is that should a war come, the risk of destruction anywhere may well be as great as that in "target" communities, so there is considerable apathy to the later risk.

Space and Public Relations

Military organizations do an effective and well organized job of presenting a positive military picture of the values and necessities for ICBM launching bases. They give lectures, address service clubs and local organizations, have tours of base facilities, and are quite responsive to public opinion. These orientations do not appear to be "Madison Avenue" type propaganda campaigns, but a sincere and somewhat dedicated approach toward establishing good relationships.

Community organizations, particularly those composed of business men and/or Chamber of Commerce type groups, also do an effective job in propagandizing their own communities. A Chamber of Commerce will work unrelentingly to get military installations into its area. We found very, very few instances of any negative reactions on the part of the public and the only complaints registered are usually on the basis of personal inconveniences, as for instance, the parking problem, and an overcrowding in some service facilities. In most small communities the military inter-mingle with the civilians in civic projects which aids considerably in the public acceptance of military establishments. Many communities suffered a long lapse between the time World War I units were deactivated and space-age missile bases appeared, and the citizens seem to appreciate more fully the economic advantages of having the military in their town.

Although a large amount of publicity had been given to a Titan Base under construction in the Denver area, the response was one of indifference. The Denver papers had not received one letter to the editor in this regard. The head of one of the missile contractors Community Relations Office felt that if one were to take a survey, only about 50% of the people would realize that there was a missile base going into the area. He conjectured that because their company had been located in this area for some time, most people felt it was merely an additional affiliated installation. On the other hand, he thought that full acceptance by the community was possibly due to full page ads and excellent coverage given to the installation by the Denver papers with an almost daily photographic description of the progress of construction.

Accidents

There is probably more public expression of anxiety in relation to accidents at missile sites than there is to becoming a victim of an enemy nuclear attack. The anxiety appears to be less justified. An accident ratio (if one were computed) in connection with missile and rocket firings would be extremely small. Statistically speaking, a new cliche holds true, "One is safer in the nose cone of a rocket than home in bed."

In the *Air Force and Space Digest* of July, 1960, we read of the occurrence of the first missile accident fatality since the start of test activities on Cape Canaveral ten years ago. One civilian technician was killed and nine others injured in an accidental explosion during Titan ground handling operations.

However, as a bit of counter-evidence to the safety claimants we have, from *Time* of June 2, 1958, an article entitled "Death in the Neighborhood."

> "Before the 526AAA Missile Batallion installed batteries of Nike-Ajax Missiles in northern New Jersey three years ago, the Army carefully explained that the 21-foot projectiles were accident proof. A missile battery was no more dangerous than a gas station. Last week ordinance technicians accidentally detonated a missile. The explosion touched off seven more Nikes, killed ten men, and showered a three-mile radius with fragments. Army lawyers began to settle claims for shattered windows and broken bric-a-brac."

In the wake of this explosive afternoon, *Time* editorialized that it would be hard to convince the neighbors in New Jersey, or around other Nike complexes, that living along side atomic warheads was still like living beside a gas station.

Again, from *Newsweek* of October 6, 1958, in an article entitled, "Destruct and Danger":

> "Just forty-three seconds after a Navy Polaris test rocket blasted off from Complex 25 at Cape Canaveral one day, the squawk boxes roared, 'all personnel take cover, take cover, take cover.' At the time the 25 foot, two-stage vehicle already ten miles high was swallowed up in a thick cloud bank, but at central control the electronic eyes and ears were telling the Range Safety Officer that the solid fuel vehicle was heading inland rather than out over the Atlantic as planned. Without hesitation he pressed a 'destruct' button, sending a radio signal that triggered an explosive charge in the runaway rocket. The Polaris burst apart, hot metal and fuel rained down on the Cape and on the Banana River, separating it from the mainland. Thanks to the warning, no one was hurt on the base. Fortunately, nearby residents also escaped injury, although, Herbert Carver, the owner of the next-door trailer park, claimed one chunk as big as a sawblade closely missed him and his wife. The incident, however, did raise a question of just how safe are citizens living near missile bases. The answer is reassuring. This was the first accident threatening a residence since the Cape began testing in 1950. So far the 'destruct' has worked every time, with one exception. The Air Force estimates the odds against any one person getting hit should a missile fall in Florida is about 60,000 to one."

We have a few other isolated instances of mishaps—a drone plane or a Matador missile escaping, a Bomarc exploding at Eglin Field and at McGuire Air Force Base, an Atlas exploding at Vandenberg Air Force Base etc. But there appears to be little public reaction regarding any great danger existing from accidents occurring on a local basis.

(We are not discussing here "war by accident," which is altogether another topic.)

Noise

The impact of a far reaching space development program has less immediacy upon an individual than having his front picture window broken by a baseball, but if the baseball is thrown by a pilot in a supersonic aircraft 40,000 feet up and 15 miles away, he has been contacted by space. The sonic boom is all around us. No part of the United States retains its Mach 1 virginity unpenetrated by noise.

Fort Walton Beach, Florida, is the "home of the sonic boom" and proud of it. From the *Air Force Magazine* of January 1960, we learn how this gulf coast city of 12,000 population next to Eglin Air Force Base has learned to live with the tests of new supersonic weapons. The sonic boom at Eglin is routine and represents security in the minds of defense-oriented persons; people in Fort Walton are no longer conscious of this noise.

The noise of the rocket tests in the San Fernando Valley is another exhibition of the remarkable ability of children (and their pets) to adapt to new and changing situations in their lives. This is noise with a capital "N." There seem to be no effects noticeable on a group of young children when the thunder reverberates through the hills. As far as most of the adults are concerned, it is like living underneath a sewing machine factory.

In the same general perceptual area, people in Southern California pay little more attention to satellites such as Echo 1 than they do to the resounding traffic which is going by. The sight of the light reflected from this 100-foot diameter balloon trailing across the sky and visible for long intervals, no longer creates any sensation among the spectators. In fact, there are few who bother to go out and look at it. It must be like fire-breathing dragons, "When you've seen one, you've seen them all."

Information and Space

Every literate person "knows" that the human race is going to the moon, Mars and beyond. The fact that over the past few years there has been an almost casual acceptance of such a technological development either bespeaks a fantastically increasing curve of acceptance of technological advances, or the outstripping of the information level which can be accepted by a large populace. The "information" on what is "possible" in terms of speed alone seems to indicate the latter. At one-million miles per hour the nearest star is only three thousand years away. At ten-million miles per hour which

is certainly theoretically possible in the vacuum of space, Proxima Centauri is only three-hundred years away. Go to one-hundred million miles per hour which should not be beyond atomic energy, and the thirty years to Proxima Centauri now looks reasonable. The next jump would be to one-billion mph and we would have to pass the universal speed limit of six-hundred and seventy million miles (670,000,000) per hour, the velocity of light.

It is not possible to propel tangible objects to speeds which approach, let alone exceed the speed of light. Although science fiction writers need not apply the laws of physics, a high speed still requires an amount of energy proportional to the square of the speed. If there is a moral in this recital, it is related to the level of information upon which a person bases his judgments. Don Michael and his fellow SPSSI researchers, in detailed questionnaire survey on information on Man-In-Space, came out with findings which indicated the information level as being a problem area worthy of a second look.

Summary

What began as an article on "Life in a Missile Community" developed into a reflection of the speed to which our culture has adapted to a running technological experience. From an inquiry directed to a few citizens in medium-sized towns, newspaper editors, military officers, etc., we have made some generalizations to a missile community of 175 million persons and perhaps the entire world.

How do they react? What has happened to them? From the rather complacent attitudes we see there has been a matter-of-fact acceptance of the exploration of space. The satellite program has started and the rockets are hitting their targets (headline-wise) with increasing accuracy. More money is spent in localities which welcome such dividends and there are broadening interactions between military and civilian groups. As one editor wrote—"some of the military have married local girls, and some others should."

Our information indicates only slight, and sometimes barely noticeable, impact on the behavior of our citizens. Although most scientists engaged in rocket research predict a landing on the moon in a few years, we would predict that such an achievement will be casually accepted. The impact of the effort to get to the moon is what we are experiencing now. The effects on us are small. Perhaps the terrestrial problems need solving first before the interplanetary ones can occupy a greater part of our attention.

Children's Drawings: Satellites and Space[1]

Rhoda Metraux

Children are a very important audience for representations of real and fictional space activities, and adolescent boys include a wide variety of activities directly or indirectly related to space among their possible career choices. However, we know relatively little as yet about the ways in which children themselves—especially younger children—conceive of space and space activities.

For some adults the launching of Sputnik I, on October 4, 1957, meant the "beginning of a new age"; that is, the necessary reorganization of experience meant for them a break with the past. On the morning after the news of the launching flashed across the country, two middle-aged men and a woman stood gazing with fascinated attention at the immense revolving globe in the center of the lobby of the New York Daily News building; watching, they reminisced about their difficulties, as school children, in grasping the idea of latitude and longitude. Their focused attention and their conversation, taken together, suggested that in some new way they were suddenly able to place themselves imaginatively where now, literally, they stood—

[1] Background materials for this article are drawn from those collected for a study of high school students' images of science and scientists undertaken in 1956, under the auspices of the American Association for the Advancement of Science and the Institute for Intercultural Studies; see Margaret Mead, and Rhoda Métraux, "Image of the Scientist among High School Students," *Science*, v. 126 (August 30, 1957), pp. 384-390. For background, the article also draws on current work in the analysis of space materials undertaken for the American Museum of Natural History project, The Factor of Allopsychic Orientation in Mental Health (National Institutes of Health, Research Grant M-3303, C1). The school children's drawings, discussed here, were obtained as part of a larger body of materials, which also included verbal materials from adults, concerned with responses to the initial announcement of Sputnik I for a study of the Changing Image of the Scientist made under the auspices of the American Association for the Advancement of Science and the Institute for Intercultural Studies, with a grant from the Rockefeller Foundation. The sample used in this analysis consists of some 850 drawings by children ranging in age from 6 to 15 years, but mainly in the lower elementary grades, in six schools located in Belmont, Massachusetts; Dearborn, Michigan; Livingston Manor, New Jersey; New York City and Saratoga Springs, New York; and Halifax, Nova Scotia. For comparison, we had a series of school children's drawings of "the scientist."

slightly removed from the earth looking toward it. But what about children, for whom this movement toward space could be part of their evolving awareness of man and the earth and the universe?

The Value of Drawings

Children's drawings of satellites can give us some understanding not only of their ideas about satellites but also, as they place the satellite in a setting, of ways in which they visualize the surround. Equally important perhaps, their drawings can tell us about the information they are picking up and the ways in which they are clustering details in wholes that may then provide working models for their own later elaboration. In 1957, a series of pictures of "the scientist," drawn mainly by elementary school children, was collected to supplement statements about science and scientists written by high school students. The first satellite was launched while we were still collecting materials, and we at once asked a small number of schools, where we could alert someone who could take quick action, to have children draw the satellite instead of—or in addition to—the scientist. Since we hoped to catch the children's early impressions as they learned about the launching, we used only drawings made within the first two week period (by October 18, 1957). As happens in situations in which it is urgent to take immediate advantage of a unique, unscheduled event, the sample is of a kind which lends itself best to qualitative methods of analysis designed to elicit common themes and regularities of performance from somewhat diverse materials. Particularly with a sample of this kind, it is necessary to surrender to the actual materials—to ask only those questions that arise from the data and to arrive at conclusions that do not preclude others.

In setting up the working context, teachers were asked to provide drawing materials and to tell the children only to "draw a picture of the satellite." However, different schools, classes, and individual children had had various kinds of information and made their drawings under various circumstances. For example, the fourth grade in a New York City school had spent the previous afternoon at the Planetarium (and one boy had accompanied his parent throughout a series of satellite interviews); the second grade in a Massachusetts school combined a spelling and writing lesson with the making of the drawings and, on the back of the paper, formed sentences (the satellite "is round like a cup") from words and phrases written on the blackboard. In the Halifax orphanage, the older pupils at least had been presented with a lecture on the satellite as it appeared to observers in a nearby observatory. And, of course, all the children had been exposed to mass media representations and to the interpretive remarks of adults and other children around them. It is significant that only a very few (mostly among the youngest ones) were unable or unwilling to at-

tempt the task. [A few first or second graders drew shapeless blobs; one child drew a gay flower garden. A seven year old boy drew a picture of "scientific skycars and microwaves"; several boys drew space ships and one stated his opinion that "rockets (and) jets is what we should think about." One girl designed a "boat-plane-car," complete with beds, rugs, stove, and closets for clothes.] For most of the children, the satellite was a physical object with definite properties.

Differences by Sex and Age

Within each school and class, the drawings are quite individualized, and children differ considerably in the complexity of what they attempt to incorporate in their presentations. Over all, the satellite takes a great many different shapes suggesting globes, ovals, 'cigar' shapes, 'jet' shapes, 'kites,' 'baskets,' and so on.[2] But individual variations are less significant than the common features; in fact, the satellite was pictured in a limited number of ways that were already quite highly stylized. A relatively small number of design elements were combined and re-combined—but differently by children in the same class, in different classes in the same school, and in different schools.

The drawings made in each school and (in the four cases where this was possible) in each class were analyzed separately so that, even when a cross-cutting analysis (by age or by sex) was made group styles and individual variations within a group style could be kept sight of. Only by so doing was it possible to reach conclusions about regularities of performance that transcended geographical location. No one kind of representation is characteristic only of any one definable group, and yet there are discernible differences when the drawings are grouped by sex and by age.

Common to all groups is the vividness of the colors. Monochrome drawings are not unusual, but—in contrast to the usual pallid presentations of scientists—satellites are likely to be pictured in bright and contrasting, not necessarily naturalistic, colors.

Boys and girls use much the same repertoire of design elements, and nevertheless their productions are quite clearly differentiated. Boys concentrate on movement. Looking at a characteristic boy's drawing, the satellite appears to rush through space. If it is rising above the earth, 'rise' lines are likely to be shown; if it has an orbiting rocket, this may have an upward tilt; its fiery tail curves or streaks out behind it. Even the crayoning of blue space may have a

[2] In analyzing the drawings, I made use of a number of simple descriptive categories of form ('cigar' or 'jet' shaped satellites; 'rays' or 'antenna' or 'beaks' for external protuberances, etc.) to distinguish types of detail. These reflect my own associations rather than the artists' intentions, and they are retained here simply because the actual details are not reproduced in illustrations. To differentiate them from the children's own statements, they are set in single quotation marks.

quality of motion. In contrast, girls' pictures tend toward ornamentation (rather than containing functional "machinery" as the boys' pictures sometimes do) and balanced formality of design. The surface of the satellite may be adorned with "rays" or "starpoints" or "scallops" (or all of these), with dots or circles or "windows." In the Halifax school, the drawings by older girls (over 10 years) have much the quality of bright wool embroidery designs. Girls, far less often than boys, include rockets with their satellites or as subsidiary parts of their pictures. And even where, as in boys' pictures, the girls represent fiery meteor-like tails streaming behind the satellite, these give a sense of stopped motion. So where boys appear to be moving actively out into space, girls turn all of space into a bright but motionless still.

The other major grouping, cross-cutting sex, is by age. Younger children, particularly in the first two grades, focus on the satellite itself and, without any surround, the satellite itself often fills much of the drawing space. (However, some six-year olds attempted much more complicated representations, and some junior high school students were satisfied with the basic satellite design.) Younger children, like many others in the sample as a whole, most often picture the satellite as round and "globe"-like (not "like a cup," even in the class where the teacher so described it), sometimes with no protuberances of any kind, sometimes with four "antennae" at right angles, sometimes bristling with a large number of short "rays." Sometimes the globe has one or more "windows," occasionally a "door." Other children (one class especially) drew an oval satellite; then, transferring a familiar image, the satellite (particularly as drawn by girls) may have a "beak," a "tail," an eye-like "window." The bird-like quality did not come through to the analyst immediately, but when it did, a whole group of drawings which worked with this image fell into place.

Drawings by older children are more complex both in the way the satellite itself is pictured and in its surround. The satellite is, characteristically, globe-shaped, but sometimes it is attached to a rocket or has a following rocket; it may have a flowing, fiery "tail." Little "waves" (of sound?) come out of the antennae; various machine-like bits are attached to the surface or are visible in the interior. The analogy to a living creature is less evident; the satellite is mechanized.

The sky—blue, black, or grey—is the simplest surround; the satellite is definitely located in space. The sky may be lighted up by moon and sun and stars (sometimes undifferentiated bits, sometimes carefully drawn so that a closer, or larger, sun or moon—or both—can be clearly distinguished from distant stars). The focus of attention, smaller than when it appears alone, the satellite moves out in space, sometimes rising, sometimes turning in its orbit. A most elaborate picture by a fifteen year old boy, labeled "the universe," shows all the planets (named) in the solar system in orbit around the sun and, in an area labeled "western skies," a tiny satellite with a meteor tail.

Sometimes the satellite is shown about to rise, or rising, with its rocket from the earth; or it is shown in orbit, or no satellite but only an orbit "line" is shown. More often it moves freely in space. But even then the world is part of the total picture. One very characteristic theme is the 'emergent earth': at the bottom of the paper, or in one of the corners, the curve of the earth is shown. As in a contour map, green or brown and blue may indicate land and water; or stripes of color may be labeled "England," "France," and so on. The consistent, recurring feature is the partial representation of earth at the edge of sight, with the satellite more centrally located in space. (Occasionally the sun is similarly treated.) In these pictures, the viewer is located not on earth but at some point in space from which the satellite and earth—as well, sometimes, as the sun, the moon, other planets, stars—are simultaneously visible. Even when the satellite is shown "as the eye sees it" (one picture was so labeled by a boy), the viewer is usually above, looking down at the earth—perhaps at a scene of trees, grass tufts, and hills—and simultaneously at the rising satellite.

Human beings are seldom included in the satellite drawings. But when a synthesis is attempted (when children were asked to draw both a scientist and a satellite and tried to portray both in one picture), the situation is reversed: man and the satellite are viewed from the earth. Only rarely does a boy make a science fiction picture of men in a space ship; in one picture by a boy, the head of a scientist in a space helmet emerges onto the paper out in space where, according to the artist, he is "checking up" on a whole cluster of different small satellites. Man is still earthbound. And unless he is actively working on a satellite located on the ground, indoors or out, he characteristically "watches" (through a telescope, a spy glass or binoculars), "listens" or "tracks" the satellite or "tells" someone about it. In some classes drawings were given titles or had accompanying legends or a few descriptive sentences. In girls' drawings, the scientist (man or woman) is more likely to be looking out at the audience than at the satellite—or the telescope does not really reach the viewer's eye. In both boys' and girls' pictures there is little to suggest that the human being controls the satellite except by observation. Once out in space, it sends but it does not appear to receive messages.

Yet the satellite may carry a political message. A few satellites have on them the letters "USSR" (or "Russia") or a hammer and sickle; occasionally a swastika is substituted—suggesting that for these children the two symbols have merged as a single representation of an enemy.

The Representation of Space

Three things are outstanding about these drawings of satellites in space. First, however simplified or distorted the representations of the satellite may be, they bear some relationship to reality (or at least to

reality as it appears in schematic adult productions) rather than to fantasy alone. When fantasy enters in, children can follow their own bent—as in the class where the teacher used the image of a "cup," but the children (in part) made an analogy to a bird. Children, like adults, may be speculating about the possibilities of life on other planets and may project their daydreams and nightmares into space, but in a given task they are also able to exercise control and represent the satellite both in ways that are expressive of feeling (chiefly through color, balance, and movement) and in terms of the fragments of information available to them. Furthermore, within two weeks of the launching of Sputnik I, a number of details of style were common to children in different parts of the country. Here one must recognize how rapidly new images appear and are incorporated into a shared awareness.

Second, girls have a somewhat different style of relationship to space from boys. Though no less vivid, their representations are formalized and static, where the boys become involved in action. In a very general way, this is a type of contrast which holds cross-culturally. In studies of children's drawings in different cultures, Margaret Mead found that where, for example, Manus boys drew scenes of action (fighting, spearing fish, etc.), Manus girls drew bead work; similarly, in the mountains of Bali, where the boys drew action scenes, the girls drew cakes and one girl who attempted to draw in a realistic style, using perspective (instead of the stylized, fragmented perspective used by male artists), was heavily ridiculed.[3] In lowland Bali, where Jane Belo made an extensive collection of children's drawings, boys drew action scenes and girls refused to draw at all.[4] The satellite drawings suggest that one of the possibilities for male-female differentiation which is carried by our culture is being incorporated into the new imagery of space in such a way that, although boys' and girls' images may overlap, there are sex-differentiated interpretations. One may speculate that, even for small children, different approaches to space and space activities may be necessary if girls are to be interested in space as well as boys and if they are not to reject as suitable career choices for boys the kinds of interests that particularly capture the boys' imagination.

Third, and perhaps most important for the future, is the children's multidimensional depiction of space. Once the satellite leaves the earth, in the drawings, there is no concern for the limits of the horizon. Rather, the satellite, the earth and other planets, the sun, the moon, and the distant stars co-exist in a multi-dimensional relationship to one another and to the viewer.

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[3] Margaret Mead, *Male and Female* (New York: New American Library, 1955, Mentor Book MD 150), pp. 277-278.

[4] Jane Belo, "Balinese Children's Drawing," in *Childhood in Contemporary Cultures*, Margaret Mead and Martha Wolfenstein, eds. (Chicago: University of Chicago Press, 1955), p. 54.

The Horizon

The idea of the horizon is one which has been enormously elaborated in Western cultures. The arrangement of our furniture and rooms and houses, no less than pictures we give children, emphasize three-dimensionality, perspective and the horizon. As an image, the horizon has a wealth of meanings for us, as it may stand for the future (and so, in American culture, the new and the progressive), or for expanded human capacities (as education "widens our horizons"), or for future accomplishment (as in "new horizons of science"), and so on. Psychologically, the ability to perceive and produce horizons is related to our conception of maturation. So, for example, in a study of progression in children's drawings, Marie Peneth found that, for French children, at about age five "everything important is drawn as if standing on a base line. . . . Soon a blue strip is painted along the top of the paper . . . (which) accompanies in astonishing parallelity but at some distance the line at the bottom, on which everything is happening. The space between the two is left unpainted. . . . When this gap disappears and the horizon becomes the line where earth and firmament meet, the moment has perhaps come when the child realizes that our visions, wishes, fears and dreams are linked up with the real world around us in whose middle we stand."[5]

In the satellite drawings, the satellite alone at first occupies the whole middle space. Then, as representations become richer and more complex, the satellite appears in a surround that has need neither of a base nor of a skyline. Nor (where no person is depicted) does the viewer (artist or audience) appear to need a base on which to stand or a horizon toward which to look. Relative size and distance may enter into the conceptualization, but—taking the pictures as a whole—the satellite, the earth, the sun, and so on, are shown in a free, multidimensional relationship to one another.

Even in our culture, in which we draw children on by such various means to perceive and make use of the idea of the horizon, younger children are not yet bound by it. It is possible therefore that, recognizing our own complex adult associations and pre-adolescent children's capacity for openness, we should attempt to make available our newer conceptions of space—which we ourselves, having been brought up in a different age, have such difficulty in moving into—to young children so that they may make the most of multidimensionality through their own developing associations.

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[5] Marie Peneth, "The Phenomenon of Drawing," unpublished MS. See also Elisabeth F. Hellersberg, *The Individual's Relation to Reality in Our Culture: An Experimental Approach by Means of the Horn-Hellersberg Test* (Springfield, Ill.; Thomas, 1950). It should be recognized, of course, that our uses of the horizon and the kinds of associations we make are culturally determined. In contrast, for example, in traditional Chinese painting the theme of high mountains in the background is symbolically related to the past (or the ancestors), not the future as in our tradition.

Space Jokes as Indication of Attitudes Toward Space

Charles Winick

This is a preliminary report on how the possibility of sending a man into space or engaging in other forms of interplanetary travel has been translated into jokes in actual circulation. Such relatively informal data may provide clues to the perception of an innovation which may supplement more formal procedures.

In spite of the enormous and continued interest of disciplines like philosophy, psychology, and sociology in humor, there have been no studies which examined how the reaction to any innovation was translated into popular humor. Previous studies have often been concerned with how minority groups use humor to ridicule the larger social group. Another emphasis has been the role of humor in exercising social control and poking fun at deviations. Anthropologists have stressed the joking relationship in which institutionalized teasing helps to blunt hostility. One study examined the extent to which there were racial and sexual subcultural variations in the jokes told by southern Negro and white university students.

A variety of widely publicized events seemed to be converging to create interest in travel in space, late in 1957. There were persistent reports of flying saucers, planes routinely flew faster than sound, atom-powered aircraft appeared to be a possibility, and the launching of Sputnik, all served to make the general public aware of the possibilities of space. Almost overnight, space jokes began to supplant the jokes dealing with rich Texans, psychiatrists, panhandlers, bopsters, hipsters, foreign sports cars, bars, and the "sick" jokes which had been the major themes of orally communicated humor during the previous decade. From 1957 to 1959, space jokes increased in popularity. Around 1959, beatnik jokes began to supplant space jokes. Each of these joke trends could be traced to some visible change in the social climate or to news events. A content analysis of space jokes appeared to be one clue to how the public was responding to space.

Method

From late 1957 through 1959, all the jokes dealing with space which came to the attention of the author and a colleague, were col-

lected. A colleague and the author, each of whom lived in a different part of the Metropolitan New York area, wrote down every space joke which they heard from a friend in the social situations in which jokes are told.[1] They made no attempt to seek out such jokes and did not record jokes told by professional entertainers. There is no way of knowing whether the jokes recorded constitute a valid sample of jokes in the region or how representative the region is of the nation, but it would be very difficult to establish the parameters for any jokes.

Results

A total of 944 jokes was collected. On the basis of a content analysis, each joke was placed into one of eight content categories which had been established by analysis of a sample of jokes. A joke which had elements of more than one category was placed in what seemed to be the most relevant category. The number of jokes in each category expressed as a proportion of the total, in per cent, is indicated below. Any one joke may be very amusing or otherwise especially repeatable, so that it cannot be assumed that any joke is as good as any other joke. These frequencies, therefore, do not necessarily represent the actual incidence of any one category in terms of number of exposures, because of the variations in jokes, tellers, and the circumstances under which jokes are told. They represent the different kinds of jokes in each category and thus not only the degree of interest in a kind of joke, but also the extent to which any one joke family may lend itself to different versions of the same joke.

Types of Jokes

Even though some jokes have special qualities which emerge only in oral communication, examples of each category may help to clarify the spirit and intent of space jokes.

Current Events (33.1 per cent). Over a third of the jokes dealt with visitors to Earth in terms of current events. The wide use of credit cards is reflected in the story of the Martians who switched to ordinary clothing for a trip to Earth. After dining in a restaurant, they were nonplussed when the waiter asked if they were Martians. They asked him how he could tell. "You're the only people who've paid with cash in the last month," he said. The strange qualities of people who gamble at Las Vegas come across in the story about the visitor from another planet who was gambling at Las Vegas but not even noticed until he had made fifteen consecutive passes.

White collar crime figures in the story of the Martian who went

[1] The author wishes to acknowledge gratefully the help of Elliott Horne in the collection of this material.

over to a cash register in a store and told it, "Remember, one for you and one for me is how we work things." Problems connected with the role of women are visible in the report of the Martian who kissed and hugged a traffic light. He was disgusted when he saw the signal change from "go" to "stop." "American women are all teases," he said. Evangelism is the butt of the tale of the Earth travelers who finally reached the moon. The first thing they saw was a moon man carrying a sign which read, "Repent, the moon is coming to an end." Water skiing is satirized in the comment about the travelers from Saturn who expressed puzzlement over when a water skier whom they were watching would take off. The problems of inflation figure in the story of the Martian who walked into a bar and asked, appropriately enough, for a Martini. "That'll be two dollars," the bartender said. "You're the first Martian we've ever had in here." "At two dollars a drink, no wonder," the Martian snorted.

Television Westerns are central in the story of the visitor from Jupiter who was watching a Western and mused, "I wonder why the hero has a biped on his back." Another phase of animal life in America got its lumps in the report of the conversation between two rats in the nose cone of a space vehicle. "It's not so bad," one said, "we might have been in cancer research."

The popularity of golf emerges in the story of the space ship from Venus which landed in a sand trap on a golf course. The pilot said, "What do we do now?" The co-pilot said, "Stupid, use a Number 3 wood." The artist's life figures in the tale of the space ship which landed in New York. "How do I get to Carnegie Hall?" asked the space traveler. "Practice, my boy, practice," answered a passerby. Many other elements of Americana appear in space jokes.

Unusual appearance (29.7 per cent). One way of coping with the new challenges posed by the space age is to make fun of the unusual appearance of and to robotize space visitors to Earth. Thus, a man from the Moon asked a bartender for a screwdriver. The bartender served him a drink. "That's nice of you," said the Moon man. "Now give me a screwdriver. My head's loose." Another Moon man asked for a double gin, poured it into a slot near his stomach, and said, "I really needed that one." A Martian happened to be walking by as a slot machine whirred noisily after hitting the jackpot, and as it cascaded forth a large number of coins, he said to the machine, "You're foolish not to stay at home with a cold like that." Another Martian chanced upon a roller towel dispenser, and whispered, "Madam, your slip is showing." The antennae allegedly worn by space men have come in for much attention, as in the story of the hatcheck girl who asked the two Martians who walked into the restaurant if they wanted to check their hats. "No, thanks, we're expecting a call," they said. A Martian mother visiting Earth saw some television aerials

and said, "Hey, kids, come down from there before you hurt yourselves."

A man from Neptune approached a wire mesh trash basket on a street corner. "What a shame," he told a friend. "That poor girl will freeze to death in those flimsy clothes." A visitor from the moon approached a parked automobile and said, as space travelers have been saying for two decades in science fiction, "Take me to your leader." When the car did not answer, he became enraged and kicked the headlights. "Shame on you," said his friend. "You shouldn't hit a man with glasses." The bizarre appearance and construction of people on other planets figure in the story of the divorced Venusian whose alimony consisted of three batteries a month. Many other variations have been rung on the theme of the space traveller's mechanical qualities.

Previous joke families (13 per cent). Almost every major earlier theme of the decade's humor was translated into a space story. The rich Texan story reappeared, as in the case of the Texan who said that he'd pay any price for a space vehicle he saw on the street. Its owner said, "1,850,000." "Sold," said the Texan. The former owner chortled with glee as he told a friend, "Wait till he finds out it's last year's model." The familiar psychiatrist story can be seen in the report of a lady Martian who visited a psychiatrist. "My husband thinks he's a cowboy," she said. "When can I see him?" asked the psychiatrist. "When he gets back from Eagle Pass," she said. An example of the adaptation of the panhandler story is the one about the visitor from space who was approached by a derelict. "Can you spare a dime?" asked the panhandler. "What's a dime," asked the Martian. "You're right!" replied the beggar. "Make it a quarter."

The bopster-hipster story can be seen in the Martian who arrived on Earth, saw a girl who was not endowed with a large bosom, and said, "Like man!" Foreign sports cars were given a space twist in the story of the visitor from Venus who approached a large American sedan at the head of a Times Square traffic jam. He walked over to the sedan and with a glance at the line of foreign sports cars behind it, suggested jovially, "How about coming over to the space ship for dinner tonight, and bring the kids." The bar story's transformation can be seen in the report of the strange looking green Martian who was sitting at a bar. A married couple came in to the bar and began arguing loudly. "I guess it takes all kinds to make a world," the Martian said philosophically to the bartender. The "sick" joke (e.g., Mrs. Lincoln, how was the theatre this evening), is the only current format not translated into a space story.

Puns (9.1 per cent). Puns figured in stories like that of the visitor from space who said, "Take me to your Lieder," in the music store. Another space man asked a grocery clerk, "Take me to your Liederkranz." A sign at the Cape Canaveral rocket centre proclaimed, "Out

to launch." A small boy shouted "Flying sorcerers," as he saw some Halloween witches zooming through the sky. Similar space puns abound.

Ineffectual earthlings (6.6 per cent). A number of stories directly express how inferior we feel to people from other planets. One deals with an Earth man who visited the Moon. He noticed a woman stirring some liquid in a pot. When he asked her what she was doing, she said, "I'm making babies." He said, "I'll show you how we do it on Earth." He did, and she asked, "Why did you stop stirring?" Another story dealt with an Earth man on Venus. He saw a 25-foot-tall blonde woman. "A ladder now," he said. "Your leader later." In another demonstration of Earth inferiority, a Martian consented to be interviewed on the television program, Person to Person. "I'll meet the interviewer in the restaurant on Earth," the Martian said. "Too bad he can't make it up to our place." Other stories conveyed the same theme.

Anti-minority (4.4 per cent). Anti-minority stories are found in space humor. Two visitors from Saturn arrived on Earth and were greeted by the noted comedian Desi Arnaz. "See," said one visitor, "I told you they don't speak English." In another story, two Budapest residents who knew each other met on the Moon. One said, "What a surprise. You see, the world is small after all." "No," said the other. "Budapest is big." The majority of the anti-minority space jokes are either obscene or relatively virulent.

Visitors taking over (2.9 per cent). How easily the space visitors will take over Earth is exemplified in the story of the boy who told his father that he had taken a ride on a flying saucer and taken a pill, so that he was a real Martian. "You sure have a lively imagination," indulgently chuckled his father. Suddenly there was a tremendous clatter and the father saw a number of green monsters in the street. "Lock the door, son!" shouted the father. "We're in trouble." "What do you mean, 'we,' you miserable earthling?" sneered the boy.

Two visitors from Pluto also illustrated how unobtrusively the Earth might be taken over by a new kind of "fifth column." The visitors were dining in a restaurant. At the end of the meal, their waiter whispered, "Don't you fellows remember me? I landed here last week myself."

Earthling's superiority (1.3 per cent). In a few stories, there is expression of feelings of superiority to visitors from space. Some explorers from Uranus were sent to Earth in order to bring back two earthlings. They flew to Earth and uprooted two gasoline pumps. They returned to Uranus, where the king said, "Well done. We'll breed them, and there will be slaves for all." "Not so fast," said the court scientist. "Can't you see they've brought back two males?"

Discussion

Each of these eight types of space joke represents a different method of coping with the unknown which is space travel. It is possible that people select different types of space jokes to tell and to appreciate in accordance not only with their perception of space, but also in terms of their sub-culture and their personality. The effects of these jokes are perhaps best understood in terms of what people do with the jokes rather than in terms of what the jokes do to people. In terms of the functions served by the jokes, there is no way of knowing whether the relative absence of women from the jokes denotes a realistic awareness of the role of men in space travel. The sixteen per cent of the stories which do involve women generally present women in a very hostile manner.

Almost the majority of the jokes collected express people's interest in assimilating space into contemporary frames of reference, with relatively little adjustment and a minimum of adaptation. Although the country's scientific effort is concerned with space travel and we know nothing about space people, there are many jokes about space people and practically none about space travel. In many languages the word for "stranger" is the same as the word for "enemy," and people want to make the space traveler as little of a stranger as possible. Domesticating space travel is perhaps the function served by three kinds of space jokes: those which deal with current events, combine space with other joke formats and space puns. People translate space travel into contexts with which they have already come to terms. They thus magically bring themselves closer to coming to terms with this new development and stave off the kind of readjustment which any innovation brings. It is possible that the reason for travelers from other planets always being green, if they are identified as any color, is that green is the color of safety, and we symbolically unarm the travelers by giving them this color. There is no scientific reason to believe that visitors from another planet are of any particular color.

Three categories of space jokes seem to express almost open fear of space travel: Unusual appearance of visitors to Earth, ineffectual qualities of earthlings involved in space travel, visitors from space taking Earth over. The majority of traveler stories, perhaps significantly, deal with people from other planets who come to Earth, and only a small proportion deal with earthlings visiting other planets. People project their uncertainty about the appearance of visitors from other planets into stories in which the visitors are dehumanized creatures made of wires and bolts. In these almost schizoid stories, visitors to Earth then interpret various mechanical earth objects as people. We handle anxiety about space people by downgrading them, by equating them and having them interact with machinery because we

feel we can control machinery. The extensive use of machinery may also reflect anxiety about what will happen to the body image in space, in what may be an unconscious response to much publicity about the damaging effects of space travel on the body. The space joke based on the body is one meeting place between our projection outward onto the amorphousness of space and our creation of jokes to absorb the shock of novelty occasioned by the possibilities of space.

The ineffectual characteristics of earth travelers to space and the "fifth column" of space visitors taking over the earth are other relatively direct expressions of fear of what space travel will bring. Another possible clue to people's fear of space travel is that there appear to be no "sick" jokes associated with space. Whoever makes up space jokes seemingly could not attribute "sick" characteristics to space travelers in the direct way that such jokes require.

The minority group stories appear to be unrelated to our central problems with space, but seem to be direct translations of anti-minority feelings into a previously unavailable outlet for such feelings. No other kind of space joke has as much hostility as the anti-minority story. The few stories dealing with earthlings' superiority to people from other planets represent a tiny island of jauntiness in a sea of anxiety. The considerable anxiety which pervades most space jokes is in contrast to the relative insouciance and disinterest about space reported by many public opinion polls on the subject. It is possible that anxiety and ambivalence about an issue may more easily be detected by the relatively underground channel of communication of jokes told by and to friends than by more formal techniques of public opinion polling. American students of social change might supplement more formal procedures by the kind of systematic collection not only of jokes but of graffiti, rumors, and other anecdotage in the collection of which British social scientists have productively engaged for some years.

There are no data on how many people in the New York area actually heard and/or told a space joke in the period studied. It is hoped that research now in progress will enable us to determine the incidence of exposure. Another interesting problem in the popular culture of jokes is the identification of the anonymous creators of these jokes, which constitute such a staple of social intercourse.

Keynes via the Back Door

Raymond A. Bauer

> *". . . Pyramid-building, earthquakes, even wars may serve to increase wealth, if the education of our statesmen on the principles of the classical economics stands in the way of anything better."*[1]

What I will have to say is speculation, although it is speculation which takes some data as a point of departure. The conclusion of my argument will be that space exploration has offered the business community a new incentive, a pretext, reason, instrument, rationalization—choose your own word—for supporting governmental economic policies which in another garb would be fixed by these same men as dangerously radical. In effect, they are trying (whether they realize it or not) to smuggle Lord Keynes in *via* the back door after having long protested that he would never be a welcome guest in their houses.

Attitudes Toward Basic Research

"Space" has come to symbolize "science," "progress," "innovation," and "research and development." And these are all good words. But space programs have upset some established guidelines whereby people evaluated research. Former Secretary of Defense Charles E. Wilson is reported to have said: "Basic research is when you don't know what you are looking for." Many people would still agree with this statement except they would view it with optimism rather than with pessimism. The Three Princes of Serendip have become the modern equivalent of Pollyanna: Turn over enough rocks and you are bound to find some new basic scientific principle of enormous power—and probably of practical importance.

Generalizations about historical trends are hazardous. Since I feel so critical about most other people's statements as to "how things have changed," I would like to make my own statement rather tenuous. It seems to be generally accepted that the Soviet Sputnik I brought about an increased respect for science and technology in this country. But the era of man in space was preceded by a period of rapid technological and scientific advance, probably best represented

[1] John M. Keynes, *The General Theory of Employment, Interest, and Money*, Harcourt Brace & Co., N.Y. 1936, p. 129.

by the development of atomic power. The result of these advances was not only to promote the prestige of science and technology, but to shake people's confidence in their ability to anticipate the speed, extent, or even the direction of new scientific progress.

Survey of Businessmen

In the summer of 1960, 89% of a sample of businessmen (64% in whole, 25% in part) agreed to the following statement:[2]

> I'd hate to put any limit on what will result from the space programs. After all, anything could happen. Look what has happened in the past.

Early in preliminary interviews I became struck with the disposition of the businessman with whom I was talking to assert that "anything is possible . . . you never know." With respect to the space program itself, only 6% was willing to say flatly that mining on other planets would "never happen," and only 11% rejected flatly the possibility of colonizing other planets.

This belief in the scarcely believable seems to be coupled with an increasing faith in basic and/or pure research. Among our samples, first choice as an objective for the space program was "pure science and gaining of knowledge." This choice was followed in order by: control of outer space for military and political reasons; tangible economic payoff and research results of everyday life on earth; meeting the challenge and adventure of new horizons; and winning the prestige race with the Soviet Union. It is interesting to note that "pure science" was two ranks ahead of "tangible economic payoff." One may argue that these businessmen were giving the "proper" or "blue ribbon answer"; but if that is so, it is equally interesting that the espousal of pure science over tangible economic payoff has become a blue ribbon answer in the American business community.

Actually, I found in the data some difficulty in figuring out what was meant by pure science. However, I am confident of one point, and that is that American businessman, Congressmen, and other laymen have become increasingly confused as to which activities of scientists are likely to produce tangible benefits. Probably the development of nuclear weapons and power out of an obviously "theoretical" (to be read as identical with "impractical") area, such as nuclear physics, was the decisive event in producing this confusion. When there are so many roads in the world of science and it is possible that each may lead to miraculous discoveries, how does one choose among them? How does one set priorities?

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[2] Raymond A. Bauer, "Executives Probe Space," *Harvard Business Review*, September-October, 1960, pp. 6 ff. All other data are either from this article or from the survey reported on in it.

Now I do not want to depict the American businessman as scientifically or technologically ignorant. This is far from true. The sort of confusion I am talking about stems from the very complexity of the problem. Within recent days I have heard one of our most competent mathematicians refuse to speculate on the future of computers on the ground that 10 years ago he had been completely wrong in anticipating what would happen in the past decade. In a situation of such complexity, there is I believe some tendency to rely in faith on the newer areas of development. The businessmen in my sample showed an astonishing (to me) willingness to support the civilian space program with tax dollars. In general they had a relatively liberal, although not entirely inaccurate, picture of how much we are spending on the civilian space program. However, what is really surprising is that 71% of the sample thought expenditures should be higher than they thought these expenditures actually were.

Government Intervention

Now so far, I have not talked about what I promised to discuss, namely, the bootlegging in of liberal economic doctrine—unless the willingness of the business community to increase any government expenditure may be so construed. There are four ways in which this smuggling in of liberal economics occurs. Starting with a government-financed space program it is hoped that: (1) The government will develop opportunities which industry may later exploit. (2) Government-financed scientific discoveries will evolve which will have practical applications. (3) There will be a direct application in our economy of many of the by-products of space research. (4) The money invested in the aero-space industry will "prime the pump."

Now there are varying degrees of inference in the above statements, and varying degrees to which, if they are true, they may be considered as liberal economic doctrine.

Only a very few of the largest of American businesses can currently contemplate financing profitable business participation in the space program. For example, a number of companies have done developmental work and are ready to take active part in the communications satellite program. But for almost all American businesses the amounts of money presently demanded for participation in space activities is entirely disproportionate to the profits to be derived in the foreseeable future. Some 60% of our respondents thought that business should eventually take part in the space program but could not envisage an active role for themselves at the present time. As one man said:

> I don't see how business can get in with the heavy investment that is required now. Perhaps later when the technology is perfected, business could enter the picture.

Out of this situation has come the unexpected doctrine that it is "the traditional American way" that "government explores and business exploits."[3] The development of steamships, airplanes, and railways are cited as instances in which the government made the initial investment, and/or did the initial development and then turned the activity over to business to exploit. Hearing this statement from the lips of a liberal historian or economist would not surprise anyone. However, hearing it from the lips of a spokesman for American business is another matter. I do not know how widespread this belief is, but it has become established as a pattern even though probably a minor one.

I have already argued that events of the past two decades had, in general, increased belief in the value of basic scientific research. Sputnik I apparently crystallized this belief. The space program has become an event which has clustered about it many reasons for support of basic research. It was in "space" and missiles that the Russians posed their most dramatic challenge. Basic research is justified as one aspect of keeping ahead of the Russians. Secondly, the space program itself demands research and also promises scientific discoveries. Thirdly, "one never knows" when basic research will produce practical economic benefits. In general, it is my impression that the era of man in space has increased the support of businessmen for basic research across the board. For example, I would expect that any increase in the National Science Foundation budget would meet less business opposition than it might have four or five years ago. At the same time, this support for basic research seems to be concentrated (both in the Congress and the country at large) selectively in the space program. Many knowledgeable scientists have already expressed concern over the tendency for money to be allotted to space research when the same scientific objectives—or equally important scientific objectives—could be better researched *via* non-space related methods. But our concern is not with whether the basic research dollar is going to the right place. It is rather with the fact that "space" has become both a stimulus and possibly a pretext for businessmen to support a larger expenditure on basic research than previously.

Belief that the space program will pay off in terms of concrete research and development of by-products applicable to the civilian earth-bound economy is widespread. About 75% of our respondents, and often more, thought it very likely or almost certain that the space

[3] One of my respondents phrased the issue in this concise form. Other businessmen have said this in effect, but not so pithily. For example, Mr. Ralph Cordiner, Chairman of the Board, General Electric Company, in his speech at UCLA on May 4, 1960, pointed out that one of the areas in which businessmen have *not* opposed governmental subsidies is in the development of infant industries. He pointed out that the space program qualifies as an infant (as well as defense) industry and thereby deserves government subsidy.

program would produce compact nuclear power plants, robotic devices, and new fabricating materials. But the number of men who think there will be such by-products understate the fervor with which some supporters of the space program virtually claim that it would be justified *solely* on the basis of such technological by-products. Perhaps this is to overstate the matter. However, I think that it is fair and quite accurate to say that businessmen view the space program as a government-sponsored activity which is justified to a large extent by the benefits it will bring to the civilian economy.

One of the ways in which the space program will benefit the civilian economy—one suspects—is by providing jobs which, in turn, will create more jobs, etc. Obviously the business community as a whole is generally against almost all government activities in principle. Such activities raise taxes and they expand the role of the government relative to private activities. Yet somehow, one senses that these same businessmen are ambivalent and also view such activities as stimulating and stabilizing the economy. However, such activities must be justifiable on some other basis than priming the pump. Since World War II, the defense industries have served somewhat that role. This is not, under any circumstance, to say that American businessmen have in any perceptible degree been "warmongers" willing to risk peace for the sake of munitions profits. However, the readers of business magazines will recognize the fact that defense expenditures have in general been viewed as a stimulus to the rest of the economy (even if, in the long run, they might be regarded as "a bad thing").

The Virtues of Space Programs

The space program may offer a better instrument for government economic activities than has the defense program. While national survival is our top priority goal, nevertheless the defense industry has many negative features to it. Everyone would at least in some measure feel happier if it were not necessary. But the space program has so many positive features! It is plowing the ground in which new business opportunities will grow in the long run. It advances science. It promises, and in fact in some instances has already delivered, beneficial technological by-products, and it is a peaceful—as well as a military—way of licking the Russians.

My case is hard to prove. But the editors invited a speculative article and this is what I have given them. My speculation, in short, is that a large measure of the support for the civilian space program that I found among the men sampled by the *Harvard Business Review* is due to an underlying belief that this form of expenditure of public funds will aid the economy as a whole. This belief is bolstered by what I believe to be a recently increased tendency to feel that "science

is a good thing." But recent advances in science and technology, being as rapid as they have, make it difficult for most men in either business or the Congress to decide where our resources should be expended. Since space is the area of most recent spectacular scientific and technological activity, it is therefore the "logical" area—when one can find no other basis for establishing priorities—in which to invest resources. The emphasis on science and technology, and its close association with "space" as the new area of advance, offers a very strong reason for support of the space program. I would not pretend to estimate to what extent support of the space program in Congress and the business community is motivated by manifest and to what extent by latent reasons. I have only speculated that the manifest reasons may offer a very good rationalization for the latent reasons of smuggling in Keynes *via* the back door.

A Strategy for Social Psychological Research on Technological Innovation

Gerhart D. Wiebe

Perhaps many social scientists have shared some of the perplexities that I have felt particularly since the explosion of the atom bomb, and increasingly since Sputnik. Our colleagues in the physical sciences have come into a time of consummation where developments flow from theory to experiment to confirmation and finally to application in new and tangible processes and things that burst upon us in a dazzling display. But these shining examples of intellectual creativity are too often marred in their social application by the wretchedness of human relationships. And the wretchedness in human relationships is obviously within the subject matter of the social sciences. What advances have we of the social sciences to set beside fission, fusion, orbiting satellites and radio astronomy? The apparent deficit is compounded by the fact that there are glaring social needs for breakthroughs in our area, while the marvels that the physical scientists have produced were less urgently needed. The further segmenting of matter and the further exploration of space were surely less pressing than the need to cope with the social psychological dynamics of war, dictatorship, starvation, ignorance and insanity. Aside from these comparisons between the physical and social sciences, there is the lack, within the social sciences, of a satisfactory system of priorities as to what should be studied next. We have nothing approaching a consensus as to an optimum sequence of problem solving in order to advance our science.

It is understandable then if social scientists (children of a competitive society too) experience some sense of dissatisfaction and indecision along with admiration as they watch their colleagues in the physical sciences thrusting ahead, grappling with unknown after unknown, and leaving a cumulative residue of combustible human relationships as they go. It is probably this pattern that gives rise to an anxious feeling that there must be much important research just waiting to be done in the wake of physical science breakthroughs. Perhaps the most dramatic case in point is research on Man in Space (MIS).

At the same time, there is a lurking suspicion that this whole formulation may be quite inappropriate in working out an orientation toward scientific pursuits. Perhaps social science research on MIS at this point is no more than a faddist response to the glamour of satellites and astronauts. So we arrive at a position of ambivalence: social science research on MIS seems imperative, but on the other hand, it may be a "me too" response. From this posture at dead center, we will now project some tentative feelers as to the efficacy of MIS research. Our objective is to search out a constructive strategic posture for social scientists in this age of technological innovation.

Although we are especially interest in MIS, an attempt will be made to broaden this discussion so that it applies to technological innovations in general. Thus the fact that astronauts will rise to unprecedented altitudes is less important to the present discussion than the fact that astronauts will be the small and specialized group of the population who will be certainly, consciously, directly and intimately involved in the *use* of the technological innovation. Problems relating to the astronauts stand as representatives of problems relating to those who use snorkel equipment, operate electronic computers, take a new tranquilizer. A second group of problems involving relatively few people in direct and highly salient interaction with the innovation, is composed of problems involving the managers. The problems of administration, financing and coordination are often basic to the eventual social significance of an innovation. Thus two groups of participant problems seem to merit attention: user problems and management problems.

Participant Problems

1. *User Problems.* These research problems in which the people who are involved as subjects are in purposeful and direct interaction with the technological innovation in the role of users, seem to call for a simple and direct strategy. Such problems should be sought out by social science researchers, called to the attention of those who are primarily concerned with the development of the innovation per se, and researched with vigor and dispatch. If it is feasible to do so, social science research on this type of problem should begin even before the prototype of the innovation is completed. At or before the birth of a prototype, there are often ways in which the innovation can be adapted to the humans who will be most directly involved—ways that involve points of secondary interest to the innovator. But once an innovation is in production, tools, budgets, habits and ego involvement all tend to impede modification. Substantial progress, and an accelerating rate is in evidence in this area. Studies on social science aspects of weightlessness, isolation, unusual diet, extremes of motion and temperature, as well as the more familiar studies of eye-

hand coordination, reaction time, boredom and fatigue, illustrate the considerable and increasing involvement of social scientists in user problems.

Social science studies on user problems hold relatively high promise of constructive results because uncontrolled variables are likely to be less numerous than in many other social science problems. The limited physical dimensions, and the small number of persons involved in many of these problems lend themselves to well-controlled experimental tests. Many user problems allow a degree of precision and predictable accuracy that cannot be achieved with problems that relate to society at large. Paradoxically, it may well be that social scientists will know more, or at any rate *could* know more, about the social psychological problems of manned space flight before the first flight takes place than we know, or know how to find out, about the impact of jet flight on American society some 15 years after its introduction.

Research on user problems tends to enhance the appreciation of social science research among practitioners of the physical and engineering sciences. The comparatively rigorous methodology that is generally applicable to these problems is correspondingly acceptable and familiar to our colleagues in other sciences. In a society where deference and dollars tend to flow to these sciences, the support of social science research can be, in fact is being, significantly increased by projects that are closely associated with programs that are perceived by their sponsors as primarily devoted to research and development in the physical and engineering sciences.

A note of caution seems appropriate. The dominance of the physical sciences, their relatively advanced state as sciences, and the precision of their procedures offer a rich environment for interdisciplinary research, but this environment also poses some of the problems of cultural assimilation. To cite a single example, a social scientist who gains, or believes he gains, entrée to the inner circle of physicists and chemists by the untimely application of mathematics to social psychological concepts which are neither discrete nor constant, may well do a disservice to his own science, to the general project in which he works, and most importantly, to the creativity and vitality of his own thinking. The availability of funds and facilities for social science research on user problems, if properly utilized, calls for a balancing independence of spirit and a constant devotion to scientific progress in the social scientists' own field.

2. *Management Problems.* Administrators in government and business are "gatekeepers" in relation to technological innovations. Research and development projects are authorized or rejected. Allocations of budget, lead time, facilities and staff are made. Having been made, they may be enlarged, modified, reduced or terminated by management. The tasks involved in negotiating the hazards of

previous commitments, vested interests, customary procedures, competitive opposition, bureaucratic impedimenta and skepticism toward the new are formidable. At unnumbered points along this labyrinth of management, arbitrary "stop" or "go" signals may be given. The weight of counter forces arguing for a "stop" decision will seem no less heavy to the gatekeeper because the problems that generate that weight are solvable if the gatekeeper doesn't *know* they are solvable. And the symbols of management are often such gross abbreviations of the things symbolized that contributing problems may not even be *seen* whole, let alone understood at the time of decision making.

Social scientists are being called upon increasingly to research problems of administration, liaison, management communication and coordination. Such problems often call for a merging of psychological and sociological skills with those of business administration, government organization, law and economics.

The significance of these problems lies in the fact that although management cannot say for sure that the most promising of innovations will achieve general acceptance, it *can* say for sure that the innovation will not be presented for either public acceptance or rejection.

Public Problems

In contrast to participant problems, where the people to be studied are limited in number, and are intimately involved with the innovation, there is the broad area of public problems where attention turns to the significance of the innovation for society in general.

Here there is great fascination in the possibility of prediction. What will the effects of automation be twenty years from now? How will electronic computers change our way of life? What will the progressive conquest of space do to our society?

Current Limits on Predicting

Consider MIS as an example. MIS considered as a public problem, is first of all an innovation in transportation—a matter of going farther and faster than formerly. Have we analogues? Yes, several: railroads, automobiles and airplanes. Suppose we grant ourselves the advantage of retrospect. Suppose that social scientists back at the turn of the century had had our current *methodological* equipment. What kinds of research should they have done on men and automobiles when the automobile was an innovation?

Among the problems that come to mind are those relating to the deterioration of the community as a self-contained entity; the gravitation of people toward urban complexes of increasing size; the inadequacy of streets and roads; the further separation of work from

home; the extended destructiveness of human carelessness and aggressiveness when multiplied by an automobile; the derivative effects of widely dispersed mechanical "know-how"; the reduction of differences between rural and urban expectation as to facilities and way of life; the expanded range of firsthand experiences and personal acquaintance, but a parallel tendency toward shallow rootedness.

If social scientists had addressed themselves to such problems as these back when the automobile was an innovation, they might have provided highly insightful guidance for our society. But they would not have studied such problems as these even if they had had current methodology because these problems did not arise from the first order impact of the automobile on a known society, nor would our theory or methodology allow their prediction. The automobile and many other things grew and modified the society, and the modified society facilitated further changes in the structure and role of the automobile, etc., etc. Instead of the impact of the new on the known, the impact of a technological innovation on the public faces social scientists with the impact of the new on the unknown if they address themselves to the middle or even the near ranges of the future. Our understanding of social dynamics is so sketchy that predicting the social impact of technological innovations even a decade hence is not yet practicable. Granting the considerable limitations of theoretical tools, social scientists are not thus limited only because of the state of their own science. Such factors as developmental inventions, the skill, vision and financial backing of industrial leaders, the predilections, temperament and philosophy of governmental "gatekeepers," etc., also play their part. Suppose that social scientists had tried to predict the impact of the electric automobile in 1916! Innovations sometimes move directly from infancy to senility for no apparent reason. On the other hand, it is not unusual today for very large corporations to boast that 50% or more of their income derives from products that were invented during the past decade.

In 1945, aviation was far past the status of an innovation. Both vertical flight and jet power were familiar. Still Ogburn[1] encountered great difficulty in his attempt to predict the social impact of aviation. He got little help from social science theory, declined to attach even approximate dates to most of his predictions, and missed on the prediction about which he seems to have felt most confident, namely a surge of development and corresponding use of helicopters for private transportation following World War II.

Archeologists find wheeled toys from the pre-Conquest period in Mexico, but they find no full-sized chariots or carts or wagons from that period of Mexican culture. Wheels were apparently never used

[1] William F. Ogburn, *The Social Effects of Aviation*, Houghton Mifflin Company, 1946.

in pre-Conquest Mexico to lighten labor or for transportation.[2] The highly touted invention of the wheel as a milestone in the rise of human society must be re-examined. Some forgotten Mexican Indian invented the wheel, or stumbled onto it. But apparently for centuries the people continued to walk and to carry their loads on their backs. The invention is not enough. The crucial question is how the society reacts to the new alternatives for behavior that the invention makes possible.

Incipient Problems

What then is to become of such engaging problems as those that we have suggested social scientists *should* have studied when the automobile was an innovation? Assuming present "know-how," social scientists should have studied them, not when the automobile was a technological innovation, but somewhat later as the symptoms of these problems began to emerge in social reality. They should have been studied as soon as alert and insightful social scientists could say with confidence: "This is no longer prediction. This is already in process." The appropriate starting signal is not the appearance of the innovation. It is the emergence of some meaningful social response *to* the innovation.

It seems likely that social scientists could add greatly to the vitality of their role in society, and could stimulate much constructive research if a committee, or perhaps a bureau, were established with the mission of identifying incipient social problems spawned by technological innovations, and bringing such problems and their most probable implications to the attention of appropriate groups.

Some twenty years ago in another time of crisis, Paul Lazarsfeld wrote as follows:

> The best service will be rendered by those who are able to anticipate the problems . . . and to bring them to our attention so that we are not taken by surprise. . . . If these problems are discussed in time before the different interest groups make emotional appeals for a last-minute solution, this country may be the only one to accept the impending social changes peacefully and with the preservation of individual liberties.[3]

Old Problems

The hazards of predicting general social responses to technological innovations are very substantially reduced if one predicts the extension or intensification of an existing public problem. The forces

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[2] Dr. Gordon F. Ekholm, "Wheeled Toys in Mexico," *American Antiquity*, Vol. 11, No. 4, 1946, pp. 222-228.

[3] Paul F. Lazarsfeld, *Radio and The Printed Page*, Introduction, P. XVIII, Duell, Sloan and Pearce, New York 1940.

of custom and inertia operate in the predictor's favor. Aggression among men is an old problem, and each improvement in transportation, from the domesticated horse through the jet airplane, has brought its counterpart in more effective destruction of the enemy. It takes no great foresight to call for redoubled efforts to outlaw war because space travel will almost certainly introduce new potentials for destructiveness.

Michael[4] proposes research on how farmers would react to recommendations on changing the crops they plant if and when weather satellites make long-range weather predictions reasonably accurate. The reluctance to change is well known. It is an old problem, familiar in its consequences of eroded land, inadequate diet, etc.

Similarly, the question of why people persist in living in areas repeatedly devastated by hurricanes is familiar as are the problems of how to promote learning via the electronic media most effectively (when communications satellites open new possibilities). Such problems as these have no inherent connection with innovations of the space age. But the opportunity to promote the general welfare by tackling them becomes even more apparent, or is emphasized *again*, in the context of the dawning space age. Thus an innovation may provide a fresh and stimulating perspective from which to review familiar social problems.

Public Opinion Problems

There is no doubt that an innovation, once it sees the light of day, has *some* impact on the general society. And inasmuch as our leadership is responsive to the people, the impact of any innovation on society would appear to be a relevant datum. If the social sciences were comparable with chemistry in precision, then trace elements in society would be matters of concern even if they occurred with a frequency of only one in a million. But the analogy has limited usefulness. On the one hand, the impact of the innovation that motivated Professor Einstein to write a letter to President Roosevelt carried potency to rival the strongest of chemical trace elements. But on the other, few people care about opinions on hula hoops although few would doubt that many millions of people recently had, and would have expressed such opinions. There is a large area in which simple judgement on the part of one or another gatekeeper determines whether the impact of a given innovation on the public merits sys-

[4] Donald N. Michael, "Proposed Studies on the Implications of Peaceful Space Activities for Human Affairs." A Report Prepared for the Committee on Long-Range Studies of NASA by the Brookings Institution, Washington, D. C., December 1960. A copy of this study arrived while this article was being revised. I am indebted to Michael and his colleagues for their stimulating study, and specifically for calling my attention to this group of problems and to the group referred to earlier as Management Problems.

tematic measurement by public opinion techniques or not. The inconsistency that merits the attention of social scientists in this area is that the relative significance for the general welfare of a given topic has little relationship to the chances of its being studied. And among those topics studied, their relative significance has little relationship to the comprehensiveness of the study or to the implementation of the findings. Thus for example, data on nation-wide opinion about instant coffee and the efficient implementation of these data is probably on the order of 100 to 1 in comparison with that relating to space developments. Still there is no doubt that public information, thinking and feeling about space developments will gradually seep up and have its influence on national budgets and policies, and conceivably on national survival.

Periodic studies that describe, and chart trends in the level of information, changes of opinion and the growth of alternative points of view are an invaluable aid to informed leadership. When innovations (either technological or social) achieve such importance that public support of them or resistance to them will weigh significantly in the determination of the general welfare, it would seem clear that the effectiveness of leadership could be increased through periodic and reliable briefings on public reactions. Provision for such studies, however, remains to be made.

A Free Society Coping With Change

The preamble of the 1960 Republican platform included this paragraph:

> The lives of men and nations are undergoing such transformations as history has rarely recorded. The birth of new nations, the impact of new machines, the threat of new weapons, the stirring of new ideas, the ascent into a new dimension of the universe—everywhere the accent falls on the new.

This, from a group that has often counseled more attention to enduring values and less to change, is indicative of the pressing importance in the 1960's of our society's response to change.

At a very basic level, it is change that characterizes our age. Historians show charts of major discoveries and inventions. These charts tell a uniform story of terrific and mounting acceleration in the incidence of innovation up to the present. But "discovery" and "invention" name the experience of the discoverer or the inventor. The large majority of people encounter these innovations, if they come to grips with them at all, as *change*–as things and situations and ideas that disturb their established perceptions of the way things are, and call for alterations in accustomed ways of behaving.

A forthright search for generalizations–for a *theory* of social response to change should undergird the various types of applied

studies that have been suggested, and should both draw on them and nourish them. Perhaps there is no question more heavy with significance than whether we as a society are too ponderous, too preoccupied, too comfortable, too defensive, too brittle to respond with adequate vigor and flexibility to those changes that men of wisdom could agree on as being of substantial significance to the future welfare of society. The search for basic theoretical insights regarding our society's response to change certainly merits high priority.

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